metal finishing

PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 5 No. 60 (New Series) DECEMBER, 1959

ARTBRITE

STEEL SHEETS

'Artbrite' sheets are RTB M.S. sheets (protected by hot-dip 'Speltafast' galvanizing or by lacquering) with a closely-adherent 10 thou. coating of P.V.C. film.

Available in many luxury finishes, glossy, matt, and various textures, and in a wide range of colours, the coating is resistant to abrasion and to a great many chemicals. 'Artbrite' sheets on the 'Speltafast' base are fully weather-resistant.

plus COLOUR
plus TEXTURE

This cupping test piece shows the elasticity and adhesion of the P.V.C. coating, and retention of the surface texture.

EXTRAORDINARY 'WORKABILITY'. 'Artbrite' sheets can be pressed, drawn, bent, seamed, formed and riveted—even welded, without disturbing the adhesion of the P.V.C. For all intents and purposes, this will stand up to everything that the steel sheets will stand. In sheets up to 48" wide, gauges 16 to 26 b.g. inclusive, at competitive prices.

Richard Thomas & Baldwins (Sales) Ltd

47 PARK STREET, LONDON, W.1

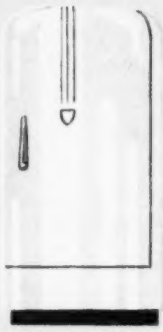
Frits!

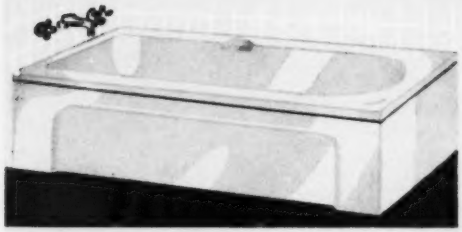
AND ENAMELS TOO

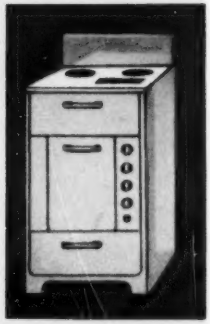
Blythe Colour Works are renowned, not only for their unequalled range of Frits for cast and sheet iron, but for their all-important after-sales service ensuring your absolute satisfaction.

Transparent or opaque enamels too, for application by wet or dry process, and concentrated oxides to give that vital spark of colour.

Blythe's exceptional facilities and recognised ability, coupled with specialised manufacturing technique, are always available to solve your particular colour problems; and remember—a Blythe technician is always at your service.







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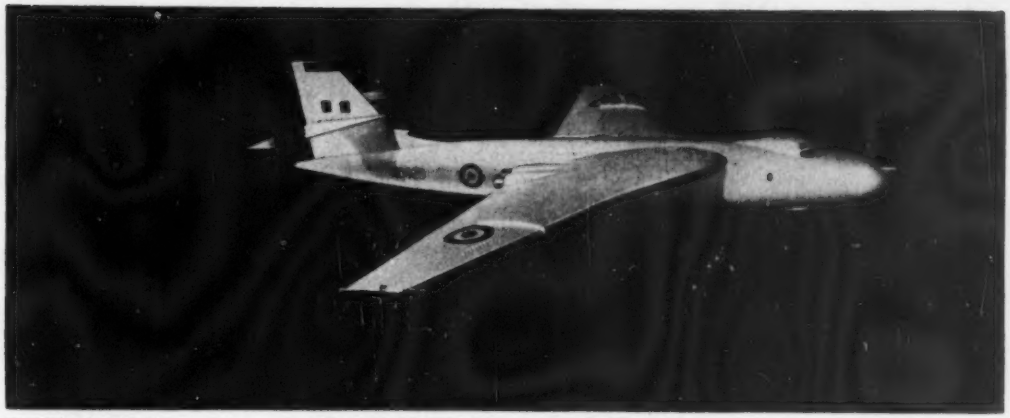


The Vickers 'Valiant' bomber owes some part of its tremendous speed to the glass-smooth paint surfaces.

The Valiant flies a little faster— thanks to ATLAS COPCO

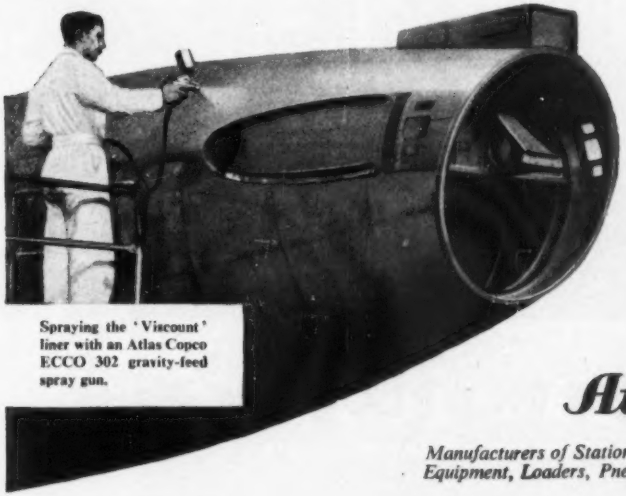
THE WAY PAINT IS PUT ON makes a big difference to an aircraft's speed. Rough surfaces cause drag—and that means slower speeds. But the mirror-smooth finish of a really good paint job gives performance a noticeable boost.

It is a fine tribute to Atlas Copco that Vickers-Armstrongs are in the process of switching over completely to our ECCO spray guns. Already they've got about a hundred of them on the job, spraying the finish on 'Viscount' liners and 'Valiant' bombers.

Atlas Copco make a complete range of spray equipment—guns of all sizes for all jobs, and hot spray units. Our guns have four particular virtues:

1 Ultra light weight
2 Simple one-hand control of fluid and fan
3 Simple design with resulting ease of maintenance
4 Remarkably even finish, saving paint and giving smoothness

We also make lots more compressed air equipment for the aircraft industry. Our drills, grinders, wrenches etc. are used for construction by such firms as Bristol and de Havilland, and for overhaul and maintenance by companies such as Air France and Australian National Airways.



Spraying the 'Viscount' liner with an Atlas Copco ECCO 302 gravity-feed spray gun.

World wide sales and service

Atlas Copco puts compressed air to work for the world. It is the largest group of companies specialising solely in the development and manufacture of compressed air equipment. It embraces Atlas Copco companies or agents manufacturing or selling and servicing Atlas Copco equipment in ninety countries throughout the world. For further details contact your local Atlas Copco company or agent, or write to Atlas Copco AB, Stockholm 1, Sweden, or Atlas Copco (Great Britain) Limited, Beresford Avenue, Wembley, Middlesex.

Atlas Copco

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment.

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" The flexibility of a " Ballard " is acknowledged ! "

It is capable of handling articles of diverse weight, shape and size and with its wide range of stoving times and controlled temperature can satisfactorily deal with multifarious colours simultaneously.

" A " Ballard " at the works of Messrs. W. Redman and Co., producing road signal lamps."

F. J. BALLARD & CO. LTD. TIPTON, STAFFS.

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ESCOL'S FORWARD LOOKING RESEARCH IS ALREADY MEETING TOMORROW'S PROBLEMS FOR THE VITREOUS ENAMELLING INDUSTRY.

- *LOWER FUSING TEMPERATURES.*
- *INCREASED DETERGENT, ALKALI AND ACID RESISTANCE.*
- *ARCHITECTURAL AND DECORATIVE ENAMELS.*
- *HEAT AND CORROSION RESISTING COATINGS.*

These are current results of our continuous research and development.

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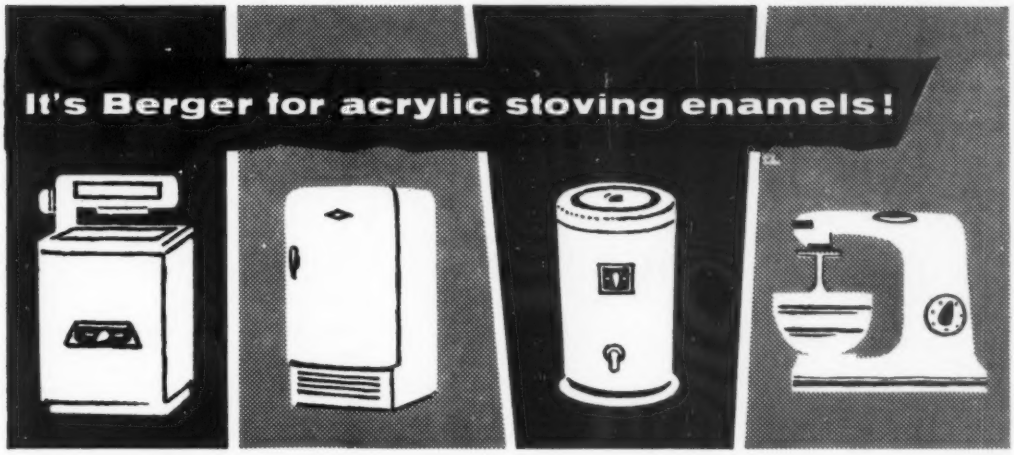

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one-coat finish is here!

✳ **PRODUCTION LINE PLUS POINTS**

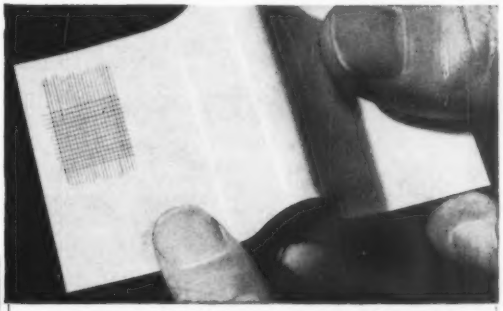
ONE-COAT BERGERCRON cuts finishing costs and gives a better finish than conventional two-coat systems. It will increase production from existing plant — with fewer rejects because of its exceptional hardness.

✳ **PRODUCT FINISH PLUS POINTS**

ONE-COAT BERGERCRON has excellent flexibility, gloss and colour retention — white stays white. It is exceptionally resistant to detergents, grease and food staining — superior to all conventional finishes.

NOTE THESE SPECIAL BERGERCRON ADVANTAGES

Detergent resistance — 48 hours in 2½% solution at 160°F.	Outstanding
Humidity — 1000 hours at 100°F and 95% R.H.	No effect
Hot fat resistance — total immersion for 16 hours at 120°F in lard/oleic mixture.	Excellent
Overstoving and double stoving.	Exceptional colour stability



Bergercron applied direct to pretreated metal. Photograph of test panel showing bend test and 1 mm. cross hatch at hardness 5H.

Berger Paints

Quality famous since 1760

POST THIS COUPON NOW!

To:

Metal Finishers Division, Lewis Berger (Great Britain) Ltd., Chadwell Heath, Essex.

Please send me more information about Bergercron.

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Company .....

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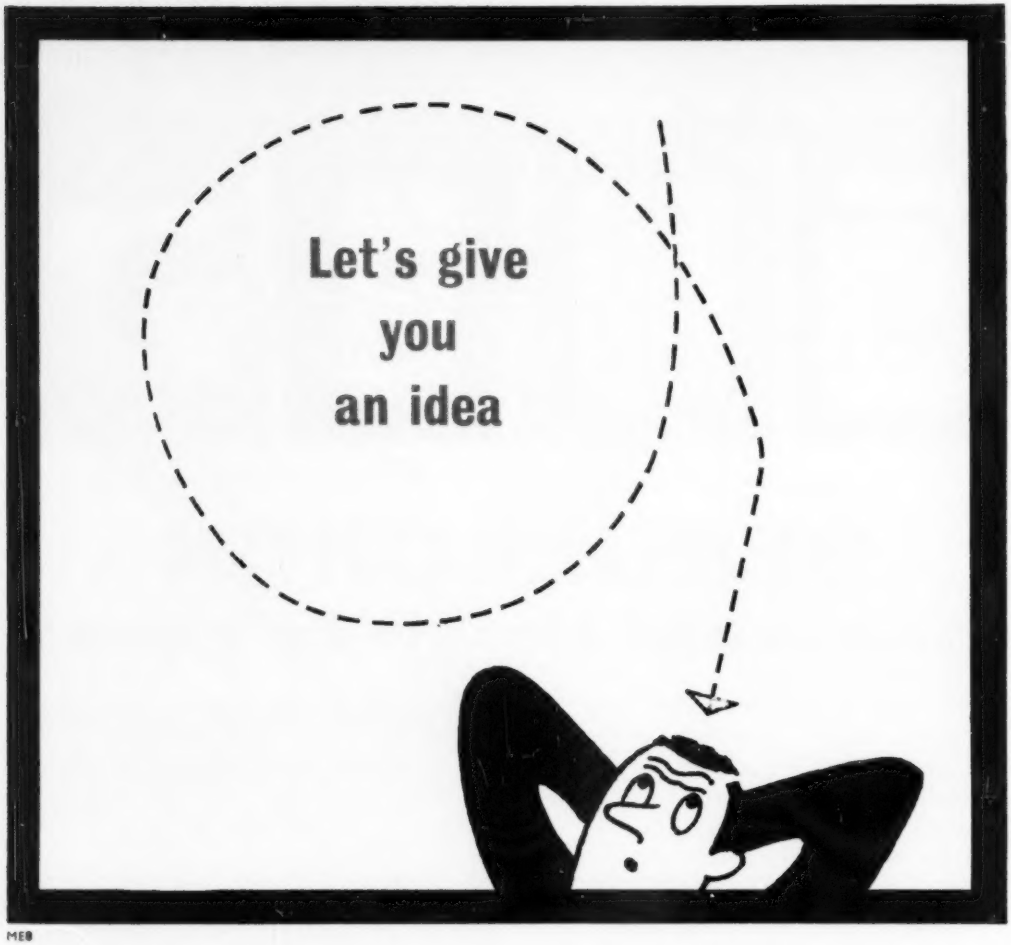

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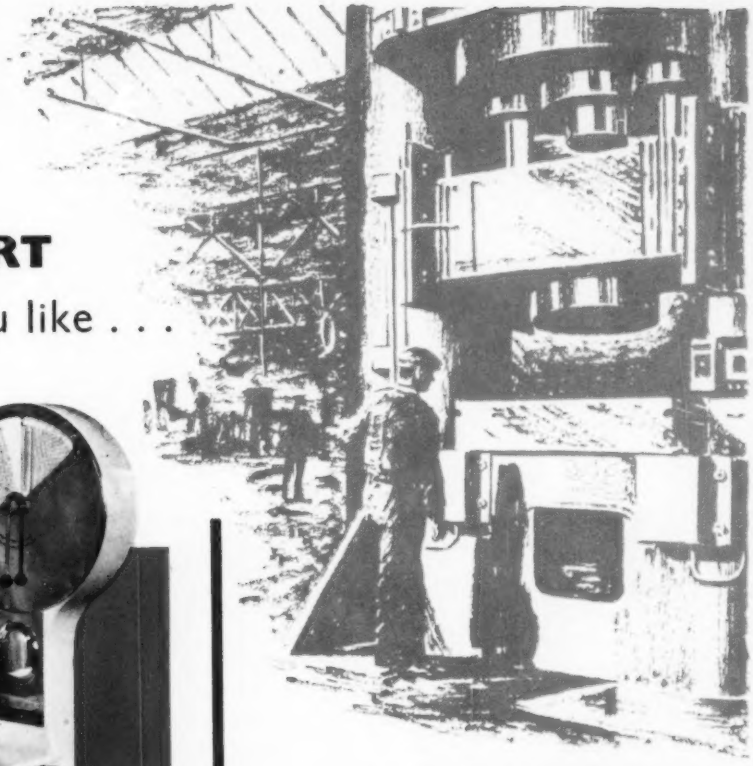
If it's anything to do with frits, colouring oxides or vitreous enamelling, we can help.

All our frits are shop-tested within our own organisation; all are proved in production and guarantee a fine finish. We are specialists in the production of dry enamels for bath finishes and can offer a fully acid-resisting and alkali-resisting lead-free enamel of exceptionally high workability. We have an enormous fund of ideas and experience in our specialised field. May we give *you* the benefit? MEMCOL is our trade name. Just write to:

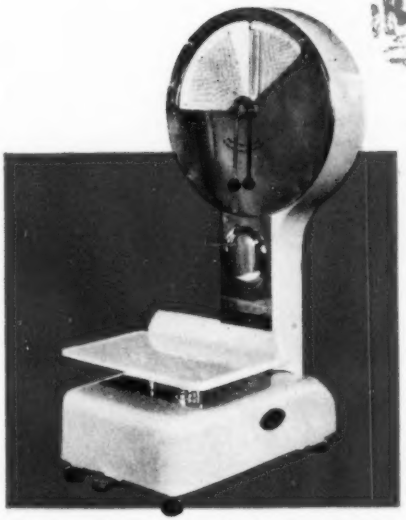
MAIN ENAMEL MANUFACTURING CO. LTD

GOTHIC WORKS, ANGEL ROAD, LONDON, N.18



START

how you like . . .



Scales manufactured by Weighmaster Scales, Leicester, finished in Luxol Stoving Refrigerator White and Luxol Standard Red Stoving Finish.

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LUXOL

There are twenty-one standard finishes in the famous LUXOL family. Almost certainly the finish best suited to your product and your assembly line is amongst them. Here are a few of the LUXOL family:—

LUXOL Standard Stoving Finish

LUXOL Quick Drying Finish

LUXOL Wrinkle Finish

LUXOL Cellulose Finish

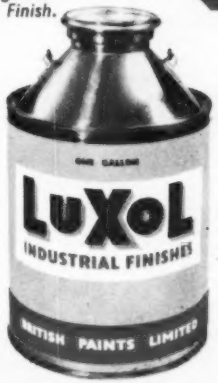
LUXOL Hammered Finish

LUXOL Stoving Polychromatic Finish

LUXOL Polyurethanes

EPILUX 2 Stoving Finish

Our Technical Advisory Service will gladly co-operate with you if your needs are not covered by our standard range and will, if necessary, formulate a Finish especially for you.



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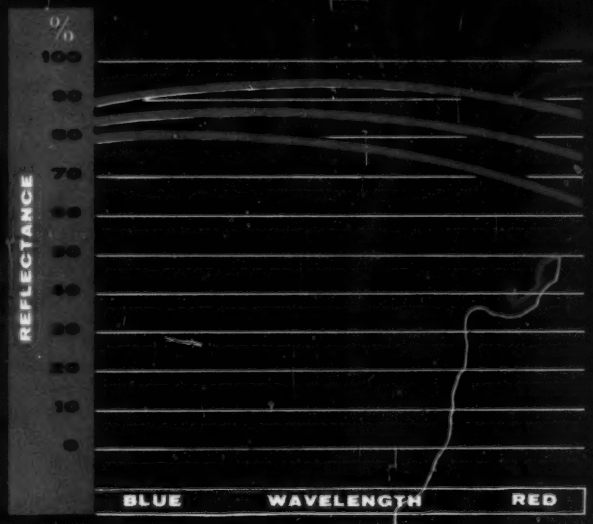
A FINE FINISH FOR EVERY PRODUCT

constant **colour tone and reflectance**

plus high density
free-flowing
easy mixing
high solubility
shorter smelting times

Tiona V

standardised Titanium Oxide for vitreous enamels in 3 types:



Tiona V C
Cream tone, (maximum reflectance)

Tiona V N
Neutral tone

Tiona V B
Blue tone

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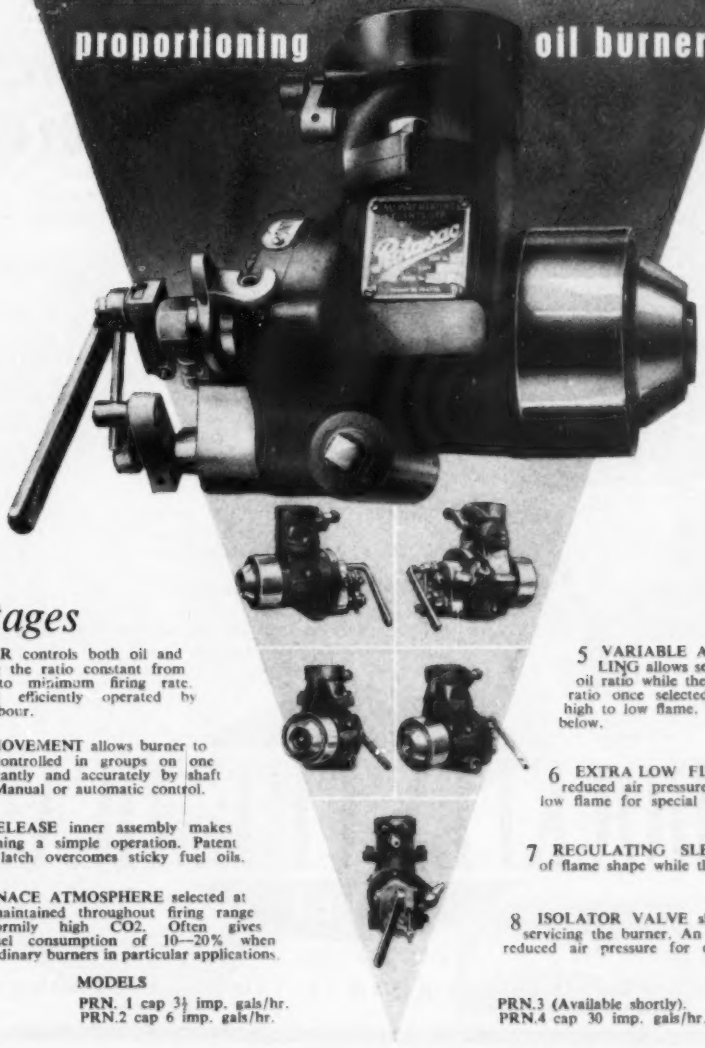
A MEMBER OF THE LAPORTE GROUP OF COMPANIES

Nu-way presents ROTAVAC P.R.N. SERIES proportioning oil burners



advantages

1 ONE LEVER controls both oil and air, keeping the ratio constant from maximum to minimum firing rate. Easily and efficiently operated by unskilled labour.

2 RADIAL MOVEMENT allows burner to be easily controlled in groups on one furnace instantly and accurately by shaft or cable. Manual or automatic control.

3 QUICK RELEASE inner assembly makes nozzle cleaning a simple operation. Patent withdrawal latch overcomes sticky fuel oils.

4 ANY FURNACE ATMOSPHERE selected at will and maintained throughout firing range with uniformily high CO_2. Often gives reduced fuel consumption of 10—20% when replacing ordinary burners in particular applications.

5 VARIABLE AIR/OIL VALVE COUPLING allows selection of the correct air/oil ratio while the burner is running. Any ratio once selected remains constant from high to low flame. For extra low flame see below.

6 EXTRA LOW FLAME SHIELD provides reduced air pressure to give a smaller stable low flame for special applications.

7 REGULATING SLEEVE allows adjustment of flame shape while the burner is in operation.

8 ISOLATOR VALVE shuts off air supply when servicing the burner. An intermediate setting gives reduced air pressure for quicker, simpler lighting.

MODELS

PRN. 1 cap 3½ imp. gals/hr.
PRN.2 cap 6 imp. gals/hr.
PRN.3 (Available shortly).
PRN.4 cap 30 imp. gals/hr.

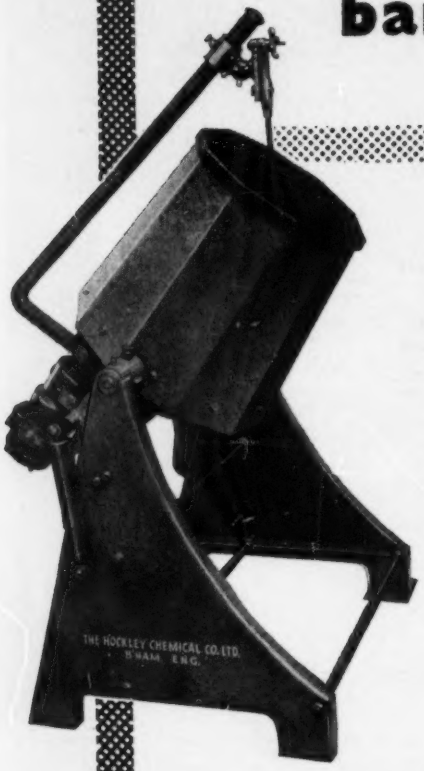
Particulars from:

NU-WAY HEATING PLANTS LTD. (Box A666), DROITWICH

and at London, Manchester, Newcastle, Glasgow, Belfast, Dublin, Bristol.

HYLTON

barrel-plating machine



HIGH EFFICIENCY

★ FOR ONLY £100 ★

- All steel construction.
- Standard ten-sided barrel with reinforced rubber lining.
- Hydraulic control for easy and smooth emptying and return of Barrel to working position.
- LARGE current capacity adjustable anode carrier with wing nut adjustment.
- Combined anode carrying arm and tilting Lever.
- High conductivity stainless steel work contacts, simplifying removal of built-up deposits.
- Barrel can be loaded and unloaded without removal of anode.
- Can be used with most solutions except chrome.

BARREL DIMENSIONS 18″ across top, 22″ across base, 22″ deep.
SOLUTION CAPACITY 10 gallons
WORK CAPACITY 3¼ gallons

This model also available with a round solid "DURETA" moulded barrel if required, at slightly extra cost.

The HOCKLEY CHEMICAL Co. Ltd.

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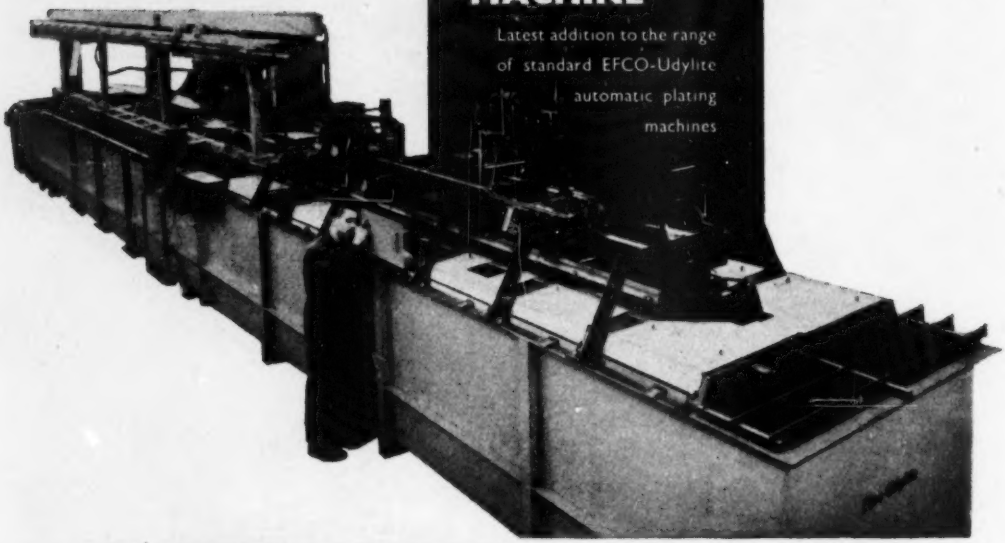
AUTOMATIC PLATING MACHINE

Latest addition to the range of standard EFCO-Udylite automatic plating machines



Efco-Udylite 'Cyclemaster'

A new automatic plating machine built from standard units and delivered assembled for speedy site installation. The 'Cyclemaster' processes from 40 to 100 racks hourly with maximum rack dimensions of 36" x 16" x 8".

OVER 1,000 EFCO-UDYLITE AUTOMATICS ARE IN USE

NEP 2536

EFCO **ELECTRO CHEMICAL ENGINEERING CO. LTD.**

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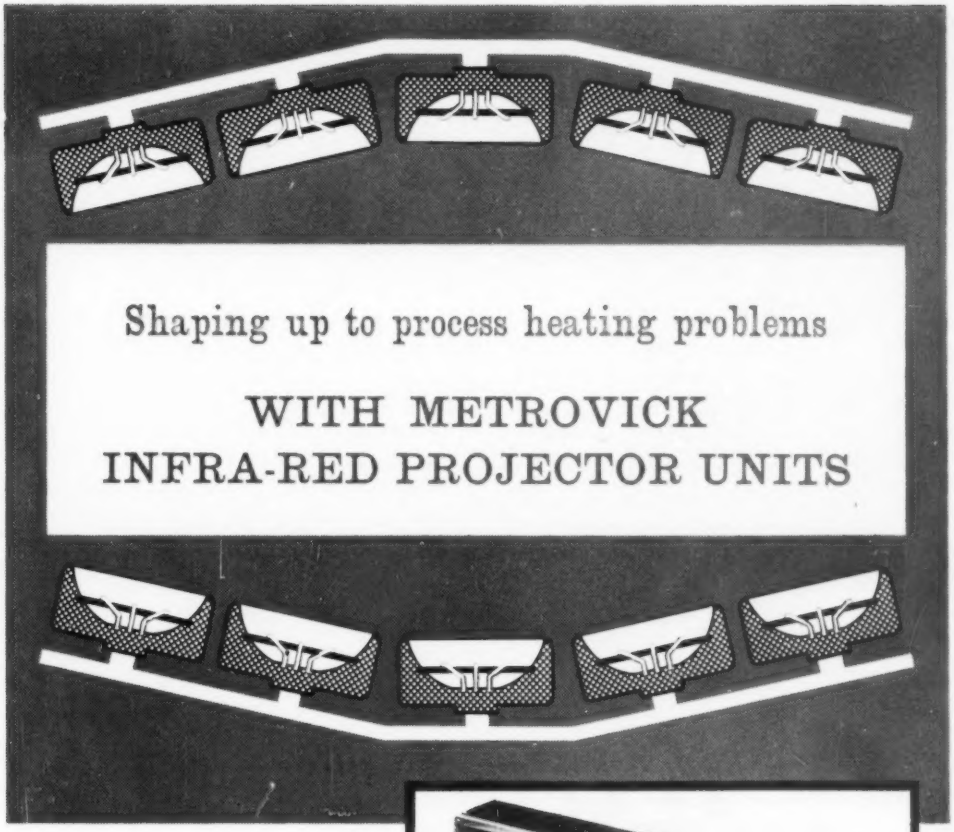

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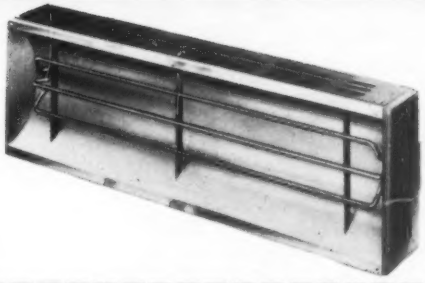
INFRA-RED PROJECTOR UNITS

With these specially designed projector units you can build an electric infra-red plant to suit your processing needs exactly. They incorporate tubular sheathed elements and highly efficient anodised aluminium reflectors, and can be readily erected in banks, portable units or used end to end in continuous troughs. They are eminently suitable for building into existing machines.

Units are available ex stock in convenient standard lengths of 18 in., 24 in. and 36 in., with ratings from 1.5 kW to 4 kW. Other special units including high intensity types are available in sizes ranging from 12 in. to a maximum of 7 ft. 6 in. long



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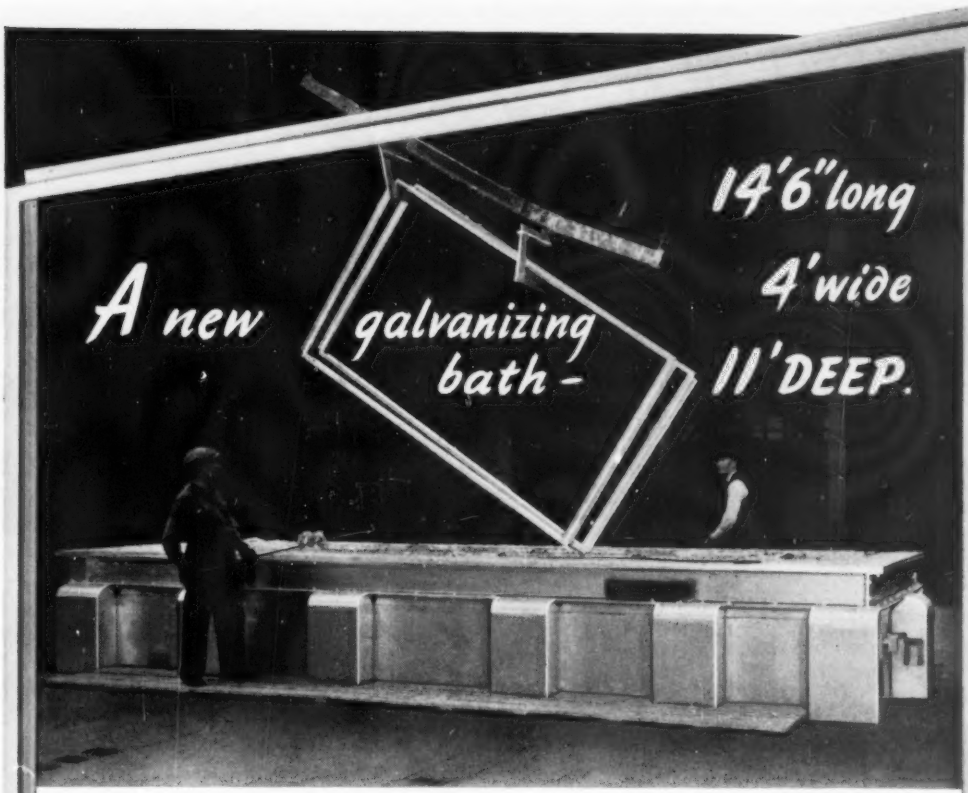


For high grade uniform galvanizing of metal windows and other fabricated steel structures

Incandescent galvanizing baths give :

- ★ temperature uniformity
- ★ long bath life
- ★ low fuel consumption
- ★ ease of control
- ★ cleanliness

With the system of firing employed, the fuel is burnt in a separate combustion chamber, the live gases being recirculated at a high velocity around the bath ensuring a minimum hot face temperature with increased bath life and uniform working temperature with no hot spots. Low fuel costs are obtained by correct burner application and the use of high grade insulation in the bath setting. The plant has automatic temperature control and is adequately provided with safety equipment giving ease of control, trouble free operation and low maintenance costs.

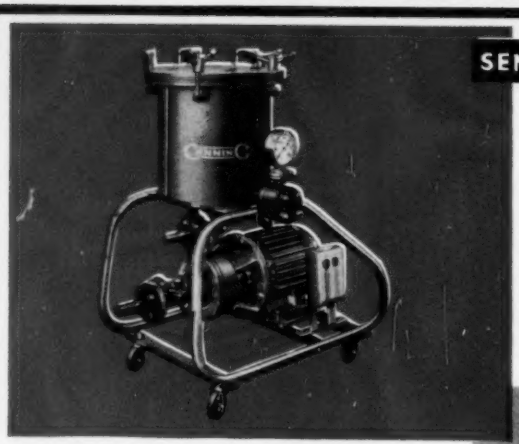
Photograph by courtesy of Henry Hope & Sons Ltd.

INCANDESCENT *Coatings Division*

THE INCANDESCENT HEAT CO. LTD. SMETHWICK · ENGLAND

10/7E/59

The New SENTINEL *and* DOME *filter units*



SENTINEL N°3130A

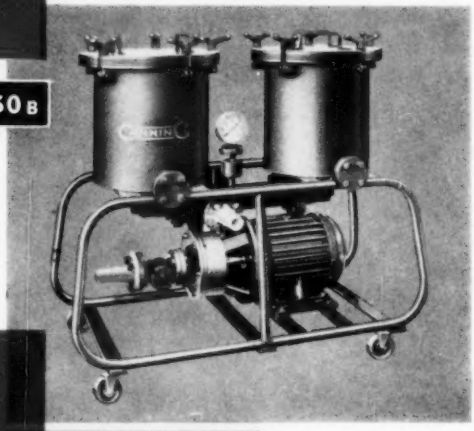
- NEW DESIGN
- LOW COST
- NEW TYPE PACK

1000 gallons per hour free delivery.

12½ SQ. FT. FILTRATION AREA.

Fitted with new type combined filter and spacer plates — giving simple and rapid cleaning and reassembling. Sentinel filters are suitable for bright nickel and other plating solutions (except chrome) at temperatures up to 160° F.

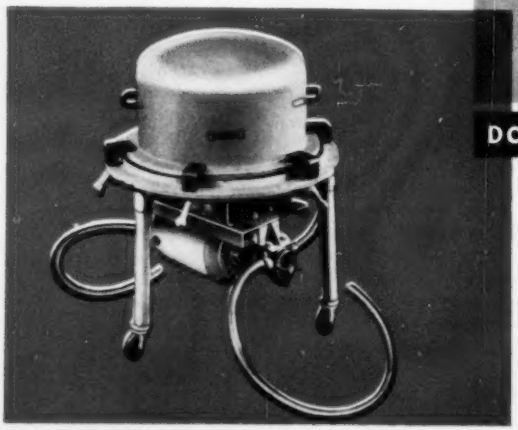
SENTINEL N°3130B



Twin unit with output of 2,000 gallons per hour, free delivery.

25 SQ. FT. FILTRATION AREA.

Can be provided, if required, with isolating valves to permit independent cleaning of filter pots.



DOME N° 3132

- COMPACT
- PORTABLE

200 gallons per hour free delivery.

5½ SQ. FT. FILTRATION AREA.

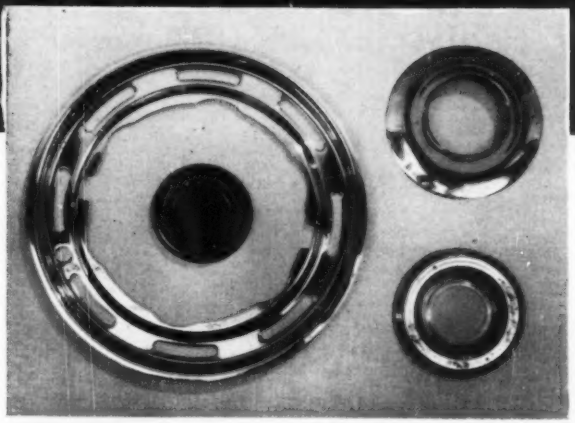
BUILT FOR THE NEEDS OF SMALL CAPACITY PLATING PLANTS.

A small inexpensive filter suitable for plating solutions other than chrome, at temperatures up to 160° F. The unit works on suction, hence there are no problems due to excessive pressure build up.

CANNING & CO LTD BIRMINGHAM LONDON & SHEFFIELD

CANNING

CHEMICAL & ELECTROLYTIC POLISHING OF ALUMINIUM



ALKUBRITE
ELECTRO-POLISHING PROCESS

For Aluminium of 99% Purity and upwards.
Gives high spectacular reflectivity on super purity metal.

★ Simple to use and maintain
★ Low temperature operation
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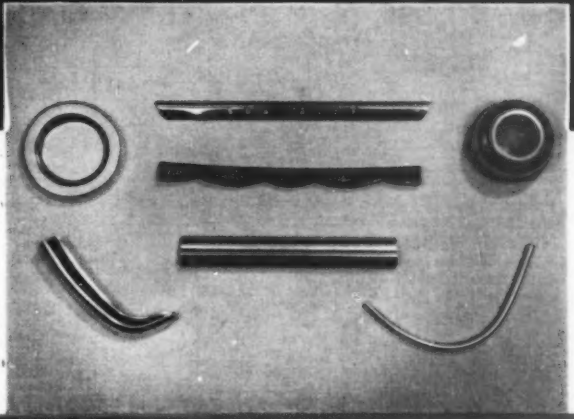

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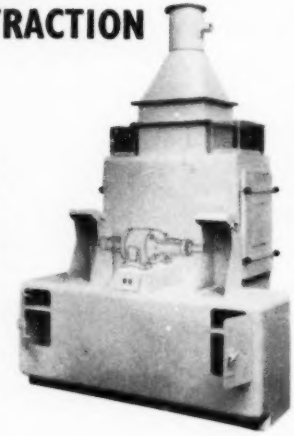

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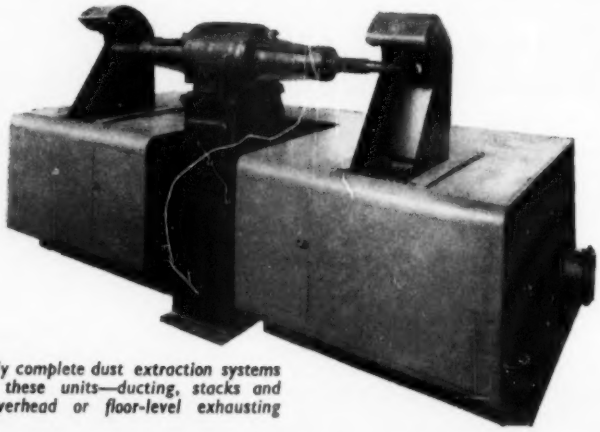

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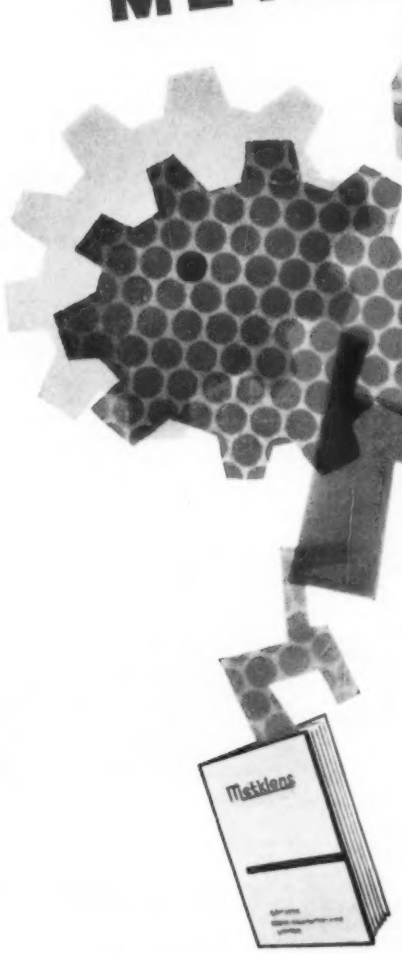

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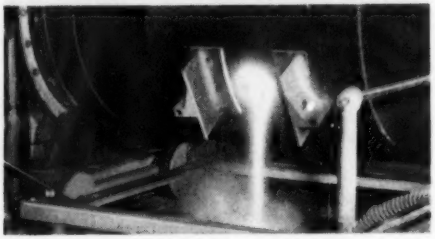

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metal finishing Journal

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

Contents

PAGE

Such Common Stuff **435**

Talking Points **436**
" Platelayer "

Progress in Polishing **437**
Abstracts of the Papers and Report of the Discussion at the first session of the One-Day Symposium organized by the London Branch of the Institute of Metal Finishing on November 18

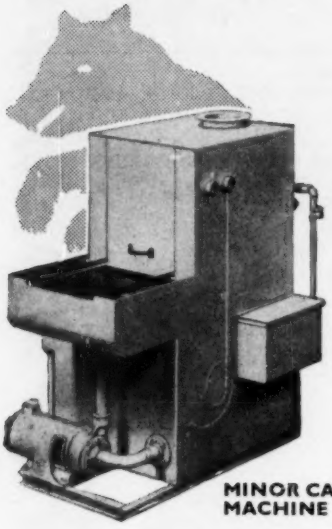
Zinc Coatings on Iron and Steel : 3—Corrosion Resistance of Zinc Coatings **445**
A.K. Parker, M.A.

Flow Coating for Quality Finishing **454**
B. van der Bruggen

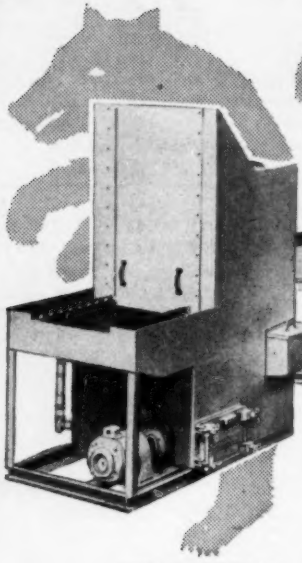
News Review **461**

Plant, Processes and Equipment **469**

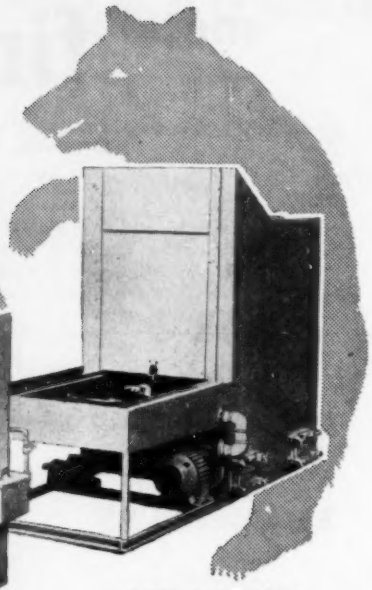
The 3 bears



MINOR CABINET MACHINE



SIZE 2 CABINET MACHINE



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SUCH COMMON STUFF

DEPRIVED of oxygen, Man and almost all his co-existors on this planet would cease to be, while the majority of industrial processes would likewise come to a sudden halt. Only slightly less immediate in its impact upon life and industry would be the withdrawal of an adequate water supply. The air we breathe and the water of which some 75 per cent. of our human frame is composed are such common stuff, and so omnipresent to meet our needs that it is only in exceptional circumstances that their availability and supply come under real scrutiny.

To the drowning man, however, or the traveller in the desert and soon probably to the pioneers exploring the surface of the moon, air and water are very much a matter of immediate concern. The fact that air is all around us and that the action of breathing is a barely conscious one, leads us to take its presence and its composition very much for granted and only passing attention has been paid until comparatively recently to the potential influence of various contaminants.

There is now coming available a large body of evidence which goes a long way to establish the price that must be paid in terms of human and material deterioration for the lack of control which is exercised over the quantity and nature of gaseous effluents voided to the atmosphere. Much corrosion of human tissue as well as of materials of construction would not take place in the absence of the products of combustion of hydrocarbons and carboniferous fuels.

In the case of water supplied for human consumption some attempt is made to remove substances and organisms which might prove deleterious if ingested, but this is far from saying that the liquid as it issues from the tap is chemically pure H_2O as is well known, to her cost, by the housewife who sees a large proportion of her soap deposited as an insoluble precipitate of calcium and magnesium stearates.

Metal finishers, and particularly electroplaters, have recently become increasingly aware of the problems and difficulties which can arise from paying inadequate attention to the quality of the water supply and the emergence of methods of producing large quantities of de-ionised water at reasonable cost has led to the use of water of distilled quality, not only for the make-up of solutions, but also in final rinsing. In this way the build-up of undesirable elements and radicles in sensitive plating solutions is avoided and much of the staining on plated components after rinsing is eliminated. The introduction of the de-ionization process has also made possible the re-circulation of mildly contaminated process water, e.g. rinse water, which has helped to overcome in several cases the problem of availability of adequate water supplies.

One of the most striking examples of this development was demonstrated by the new paint shop of the Ford Motor Co. Ltd. described in last month's issue of METAL FINISHING JOURNAL. *In this case de-ionization was undertaken to provide a high purity water for rinsing after phosphating and after wet-sanding operations on car bodies. It has been established that the salts deposited on such bodies by the evaporation of normal mains quality water used for rinsing, being hygroscopic, are capable of absorbing water through subsequently applied paint films, leading to local blistering. It is evident that this problem must have been of such magnitude as to justify the cost of removing such contaminants from these rinses which are used at the rate of approximately 6,000 gal. per hr.*

It may well be found that other operations in the finishing field could benefit in like manner.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

WE FLATTER OURSELVES

IN April last we commented in this column on the very bad press that chromium plating has been getting recently, and the fact that little or nothing was being done to counter it. It is therefore very gratifying to see that the Mond Nickel Company in conjunction with the British Standards Institution have launched a press campaign to tell the world that plating is not so bad after all. The quality labelling scheme which is being launched at the same time is voluntary at present, but at a later stage, testing of samples may be introduced, possibly in conjunction with the use of the British Standard Institution's "Kite Mark."

In the same vein, we like to flatter ourselves that people in high places read this column and promptly go into action, but it is probably only a coincidence that last month the first BEA Viscount Airliner with red-painted wings flew to Zurich, following on our reference in May to the fact that the colour-schemes of commercial aircraft seem to be calculated to make them as invisible as possible in the air.

VERB. SAP.

THE English language becomes more exotic every day; at one time it was the poets who created new words, but now it is industry which is introducing them at a prodigious rate. Technology understandably demands fresh jargon all the time, but the current use of some forms of everyday words is less justified. Thus, an advertisement in a scientific journal for a purchasing service is strangely headed: "Visioneered Procurement." Even the BBC is not immune; recently, reference was made to a pioneer who had "researched" for many years on fuel cells.

There is really no need to coin such monstrosities; the English language already has a wonderful collection of words which are quite expressive. It is reported, for instance, that the old word "struthious" has been revived with great success in the Civil Service. It is defined in the dictionary as "related to or resembling the ostrich," and is very apposite today. There are even archaic technical words which might be revived; platers in the South-west would surely be interested to know that their local water supply was described by an eighteenth century physician as *aqueo-salinocalcalinocetaceoaluminosocuprevitriolic*!

WATER, WATER, EVERYWHERE....

THE water shortage which developed during the summer had quite serious repercussions on industry, particularly in the North. One of the troubles in this country is that many of our deficiencies are so marginal that we tend to let things drift and refuse to take them seriously. Cases in point are heating and refrigeration; our climate has, up till relatively recently, been considered too mild in winter to justify full scale central heating in homes, and insufficiently torrid to warrant refrigeration in the summer. This is why 85 per cent of the homes in this country do not have a refrigerator. Precautions against drought also seem somewhat redundant in a country where the total rainfall per head of the population is no less than 50 times as great as the average consumption.

The water shortage problem is purely a matter of money. If sufficient money is spent on storage facilities, the problem disappears. The Metropolitan Water Board, which is one of the wealthier authorities, has sufficient reserves for a full year, so that no difficulties arose in the London area, despite the fact that the summer was the driest for 200 years.

ELECTRO-EVERYTHING

WHEN the electroplating industry introduced electrocleaning some years ago, it was really thought that a great stride forward had been made.

Now a new domestic washing machine is being advertised as having electro-rinsing, electro-drying and electro-emptying.

Such is progress!

CORROSION AS SHE IS SPOKE!

"The new A.T.C. (Alloy-Tin Couple) test consists of producing a current of electricity between a tinplate sample which has been detinned to the alloy state and a pure tin substance, while both are submerged in grapefruit juice containing pure soluble tin. Service life of the tinplate is indicated by measurements of the current flowing between the tin sample and the tin electrode after 20 hours."

"Financial Times" U.S. Scientific Reporter

Progress in Polishing

A one-day Symposium organized by the London Branch of The INSTITUTE OF METAL FINISHING

On November 18 the London Branch of the Institute of Metal Finishing organized a one-day Symposium at the Royal Festival Hall on the theme "Progress in Polishing." This was attended by nearly two hundred members and visitors who took part in the discussion of the four papers presented. The METAL FINISHING JOURNAL report of the morning session at this meeting which commences below includes abstracts of the first two papers and highlights of the discussion which followed their presentation. The report of the second session will appear in a subsequent issue.

ABSTRACT

PROGRESS IN MACHINE POLISHING

J. H. Bryan and J. P. Dewar**

IT is generally agreed that finishing costs often represent a high proportion of the final cost of a manufactured article and where manual labour has to be resorted to the costs of polishing are by far the greater proportion of the combined finishing costs. As a result the tendency is to mechanize polishing as much as possible.

A semi-automatic polishing attachment is usually operated in conjunction with a pedestal-type polishing motor, and the choice of attachment will depend on the shape of the article and the output required, which should be between 30 and 100 articles per hour. One operator can supervise two or more attachments so the output per operator is quite high.

The best-known attachment is the single-spindle type used for components such as saucepans, lamp-body shells, etc. The article to be polished is fixed to a suitable jig or workholder which is attached to the universal head of the unit so that the article can be set at the required angle for contact with the mop. An adjustable arm is also provided for lateral movement. Two or more spindles can be used on this type of attachment, so that continuous loading and unloading can be carried out. For large components a hydraulic unit is available and for small components of irregular shape a special type of attachment, using suitable forms, has been developed.

Automatic machines are of three main types, *viz:* rotary table; conveyor machines of the conventional return type; special conveyor machines of the universal type using mops up to 24-in. in length operating at lower speeds than the conventional range.

Rotary table machines are made for continuous or indexing operations and can be fitted with automatic loading and unloading equipment particularly when used for continuous operation, when output can be up to 1,500 parts per hour. Rotary machines are usually used for cylindrical components, which, attached to the table of the machine, revolve below the required number of polishing heads.

Conveyor-type machines consist of a straight-line motor-driven chain on which are mounted platens for carrying the jigs or workholders with a suitable number of polishing heads arranged on each side of the conveyor unit. The conveyor units themselves are of the return type, where the workholders are traversed down two sides of the structure in a horizontal plane and returned to the same position for loading or unloading, or of the "over and under" type where the conveyor traverses the length of the machine and returns underneath in a vertical plane.

Polishing heads for both the above types of machines can be of the fixed- or follower-head type.

The third type of automatic machine consists of a conveyor of rectangular shape supporting a train of carriages coupled together to form an endless train driven by a variable-speed motor unit. Workholders are mounted on vertical or right-angle spindles arranged to rotate continuously or oscillate as required. The conveyor is built in sectional form and can be extended or reduced in size by adding or taking away sections. The polishing heads can be of the fixed or floating types or a combination of both. A feature of the machine is the automatic control to take up mop wear. The advantages of this type of machine include simplicity and versatility in setting up for components where changes of design may occur from time to time.

The trend in mop design is towards ventilated bias mops, as these provide faster cutting action and are more economical in use than whole disc mops. It also appears that sisal may gradually supersede tampico, etc. In fact ventilated sisal sections have now become standard for automatic

* *W. Canning & Co. Ltd.*

machines for polishing stainless steel or for brushing operations on sheet steel pressings or spinnings prior to electroplating. Recent developments include sisal buffs impregnated with greases, etc.

There is still a demand for fibre polishing wheels but the trend is towards the ventilated type.

It should be noted that bias mops are also being used for hand polishing.

Bar polishing compounds are now available in lengths up to 26 in. giving larger production runs and less waste, and greaseless compositions are being used not only for satin finishing non-ferrous metals but also for light scurfing operations. The technique of dressing felt bobs with a thick layer of greaseless composition has developed in recent years particularly in the aircraft industry. These compositions are now available in silicon carbide as well as Aloxite.

Liquid compositions, the trend of which has been toward water-based emulsions, are used for buffing on non-ferrous metals, for buffing on stainless and other steels and for finishing. The type most widely used is liquid tripoli. The question of the economics of liquid versus bar compositions is still controversial, but the water-based liquids do make cleaning a great deal easier.

* * *

MR. J. P. DEWAR, in presenting his paper, said that if savings were to be made in metal finishing, a reduction in polishing costs would be most effective. Often the cost of raw materials and processing costs were small by comparison with finishing costs, so that any reduction which could be made at the finishing stage was more likely to be reflected in the final costing of an article.

There was a trend towards larger automatic polishing machines, mainly with more polishing heads aimed at producing greater output at lower costs. The universal type of machine was suited to modern styled components, but in considering the range of components normally handled by automatic polishing machines, it should not be overlooked that semi-automatic machines could handle a large capacity. In certain circumstances, outputs from two or three semi-automatic machines, sometimes operated by one man, were considerable, especially when dealing with medium and small components.

He showed a series of slides illustrating the range of semi-automatic and fully automatic machines. Liquid or bar composition could be used on these machines, but in deciding the polishing composition it was advisable to treat each case on its merits.

One great advance had been the use of the bias mop. The weft and warp were at 45 deg. to the periphery. By cutting on the bias the life of a buff could be increased two or three times. Great strides had been made in the last ten years with the use of sisal which was regularly superseding Mexican fibre and calico. The saving was even greater when using bias sisal buffs.

MR. BRYAN said that one of the differences between this country and those countries which had been machine polishing for many years arose from the difference in the output. The outputs in other countries were estimated at 7 to 1 or 10 to 1 by comparison with ours. Moreover, in this country it was necessary more often than not to arrange for a machine which would be more universal than was the case in the United States, where machines often did the same type of work year in and year out. In this country machines had to be changed as cheaply as possible from one article to another.

It was noticeable that while the head of a small business was quite willing to consider the introduction of machine polishing, he began to have doubts as soon as he investigated the matter because, for some incomprehensible reason, the moment there was the slightest whisper in his factory that he might introduce some form of machine polishing, there were labour troubles.

He had met this many times throughout the country, and always asked the polisher if he was a skilled man? He then explained that if he was a job existed for him indefinitely, because in 99 cases out of 100 the reason the manufacturer wanted to introduce machine polishing was that he had insufficient labour for the output which he required. The manual labour was required to tackle some of the jobs which were in small quantities or for shapes which would involve expensive machinery. He would introduce some form of automation to help him with some of the easier jobs.

DISCUSSION

MR. WILLIAMS said that the authors had referred to new types of mops and machines, but he wondered whether the tendency was to overwork the machines. In his works, for instance, far too much was expected from a machine, which was very costly in the first place. It was often very difficult to persuade management that a machine costing £20,000 or £30,000 was needed, especially when most of the polishers were still needed afterwards. In most firms, where many articles were processed at different times and often at the same time, a machine was needed which would sometimes do only part of the job, leaving the remainder for the polisher.

Polishing was an art and polishers (like artists) were temperamental. In his opinion, polishing should become a science. It was apparent from the Papers that the supply houses were of the same opinion, and he was glad of this information.

Much more control was needed over the polishing process, and he thought that the same advances had not been made in polishing as in plating.

Plating was now a scientifically controlled process. He wanted to see, in every finishing department, a polishing engineer, a man with a degree in engineering plus a thoroughly practical knowledge of hand polishing ; progress would then be made. The firm for which he worked had an apprenticeship scheme, and two years ago the general manager had decided that all these apprentices, who were training to be tool-makers, draughtsmen and engineers, must spend at least three months in the finishing department. They were taught to hand-polish articles and to set up and operate automatic and semi-automatic machines.

Recently he had seen one of them with a micrometer measuring exactly how much material he had moved in a given time. That was a step in the right direction, and in a few years' time that apprentice might be one of the polishing engineers which the industry needed. For too long the industry had relied on what he called the irregularity of quality; a lot of good work mixed with a lot of bad work. For too long reliance had been on brute force. This could be overcome by mechanization and more control in the polishing shop.

Metal Quality for Polishing

Mr. Williams also suggested that metal quality was a problem, *e.g.* pinholes and inclusions, making finishing difficult. It was necessary to have liaison with the tool makers, steel manufacturers and die casters, etc. in an attempt to improve metal quality. He was sure that such an improvement would be to the benefit not only of those who had to polish and finish the articles but also of the supply houses who sold costly polishing machines. The position would be much fairer to the supply houses and it would be possible to persuade management that it was worthwhile to have some of these machines.

If the industry were to remain in business it must compete with plastics and the other new materials coming on the market. It must produce a regularity of finish ; every article must have the same standard of finish. This would not be done with individual polishers, even though the polishers would still be needed in the industry. It could be done much better on a properly controlled and operated automatic machine. It was the individual, not the machine, who made the mistakes.

String Buffs

MR. F. W. ANDERSON said that he was surprised that the authors had not mentioned the string buff or brush made of Sea Island Cotton now freely available in this country. This served a particularly useful function on automatic machines dealing with precious metals and on such articles as lipstick cases. It was also valuable for stainless steel, particularly in the plate-ware industry, to provide the finish sometimes called the Swedish finish.

Was it not true to say that greaseless compositions of the type mentioned had been available for many years? He suggested that "glue" compounds should be used only on felt bobs or where there was a particular reaction from the bath.

MR. DEWAR replied that for many years experiments had been carried out with cotton buffs, *i.e.* Sea Island Cotton, paper core and sisal core. In general it had been found that a string buff, whether from Sea Island Cotton, paper or sisal, or any of the natural fibres, was not as aggressive and did not give the service which normally could be obtained from a buff of the usual woven material. Perhaps the cotton or fibre string buff had certain psychological values, but in practice they were very hard and there was a rapid rate of wear by comparison with the usual buff, whether sisal or calico.

Greaseless compositions were not particularly new. Mr. Anderson probably meant that they were not particularly new in other countries as in this country greaseless compositions were 20 to 25 years old. Much progress had been made with greaseless compositions—for example, silicon carbide—but he agreed that the glue bonds gave far better results on felt bobs. Many people were using fairly soft mops quite satisfactorily in connection with greaseless compositions, however.

MR. ANDERSON emphasized that the value of the Sea Island Cotton with precious metal was that there was the minimum of cut. He thought that the authors were a little unkind to the liquid composition in comparison with the bar composition and he was glad that they did not suggest bar composition on what he knew as the Harper machine, because many years ago he had to try to make a bar compound for that machine! He held the view that with a good liquid compound, coupled with good plumbing, which was essential to an excellent finish, by comparison with any bar, could be obtained. The one exception was that of Vienna lime, which was one of nature's products. He understood that the lime in Derbyshire was 3 million years old.

MR. DEWAR replied that the authors had not made any comments on liquid compositions because these were being dealt with in another paper.

MR. BRYAN said that he had always felt that polishing was the poor relation in metal finishing. It was possible to ask the managing director for £50,000 to spend on automatic plating plant without difficulty, but if he were asked for a polishing machine he wanted to know all about it. For generation after generation the man in the polishing shop had accepted any material coming into the shop when he should have refused to accept poor material and until he did this the present situation would not be improved.

MR. P. F. WALMSLEY agreed that the price of polishing machines was a most important consideration, and the machine which would do many operations for the same price had an advantage. No mention had been made of one machine which was available and which would do the grinding operations and then could be changed to the more conventional type of mop for polishing. Such a machine was available, over 100 ft. long, which would turn out about 100 radiator surrounds an hour, work which previously required 30 polishers. With the use of the machine, only two operators were needed from rough grinding to polished finish.

MR. BRYAN said that Mr. Walmsley was speaking of a speciality machine, and the authors had refrained from dealing with such machines. There was no criterion about supplying banding heads, and he was gradually approaching the stage at which he wondered whether an alternative should not be found to an abrasive band. He would not go into detail, but he thought that there were certain limitations on the use of abrasive bands which could not be avoided. When a band was travelling over a wheel it would always go to a high spot. Where there were awkward contours, this could lead to difficulty.

MR. E. A. OLLARD said many people did not know 12 hours in advance what their work would be. One problem was in the polishing of the heads of small screws. It ought to be easy for someone to devise a cheap and simple machine which would assist in polishing these components, and he asked the authors whether they had any suggestions to offer?

MR. BRYAN replied that there was such a machine and he would be glad to give details to Mr. Ollard.

Cooling with Liquid CO_2

MR. O. JONES said machine tools were cooled with liquid CO_2, and bearing in mind the flow which was experienced, particularly with softer metal, during polishing, had any work been done on cooling the work face in a similar manner?

MR. DEWAR replied that in the past a hollow disc mop had normally been used. When used in strenuous operating conditions it tended to burn. Any heat generated was forced into the calico, and, the thermal conductivity of the calico being low, it gave rise to a certain amount of burning. The natural development had been to introduce a ventilating feature to the bias buff. First, an air duct had been introduced into the mop itself so that a certain percentage of the air—not all of it—was permitted to flow through the mop, mainly because of a pumping action. A ventilated buff in itself would not allow the air to pass through when rotating until the pumping had been started. By virtue of the pumping, however, displacement air was introduced and cool air was forced through the sections. Because of the ruffled face with a bias mop, there was greater windage than with a hollow disc mop. A bias mop had one-and-a-half to two times the amount of material round the circumference as had a hollow disc mop. Thus, more air was displaced and there was a better cooling effect.

In addition, instead of being built on a cardboard centre or a calico centre, which in themselves had low thermal conductivity, the modern bias mop was built on a metal centre, and this assisted in the distribution of the heat which was generated through the metal centre plate to the machine itself. All these factors influenced the temperature of the workpiece. It was not only the amount of heat generated in one particular polishing operation that raised the temperature of a component. There was also the question of the residual heat held in the mop and imparted to the component. He had no experience of the separate cooling of components with CO_2.

MR. BRYAN said that he had seen a coolant applied to an article—kerosene, white spirit or a paraffin type of material—prior to it going underneath a polishing mop. He had been told that this was to help carry out the operation. He thought that in this country, in view of the factory regulations, it would be found a hazardous process.

With machine polishing the tendency was to move away from the question of peripheral speeds. He had been brought up on peripheral speeds but he was beginning gradually to learn that they did not matter very much provided that they were kept within a certain range. It was clear that the answer to the problem of keeping the work cool had been found, because on some of the modern machines work could be removed with the bare hands.

Nylon Mops

MR. B. J. DAVIS asked whether there had been any research into the use of man-made fibres such as Nylon in mops in order to minimize wear?

MR. DEWAR said he had carried out many experiments with man-made fibres, especially with Nylon. One of the difficulties of using Nylon was that it became plastic at very low polishing temperatures. An attempt had been made to alleviate this by interspacing the Nylon with calico, but all the time there had been fusion of Nylon, calico and tripoli composition.

An attempt had also been made to introduce more forced cool air between the sections, but he had come to the conclusion that so much heat was generated at the point of contact that it was difficult to eliminate this fusing.

Experiments had also been carried out with rayon, with similar experience. When rayon was mixed with calico the results were fairly good, but

rayon by itself frayed badly because the binding properties were not strong. Terylene reacted much the same as nylon.

MR. J. SPRAGUE said the use of expensive machines must depend on how much they cost and what was the output, as well as on a number of other factors which the authors had mentioned. In trying to put across the case for such machines to those who had to take the decision for their installation, had the authors any simple rule-of-thumb calculation which would show that at a certain output it became worthwhile to instal a machine?

MR. BRYAN replied that he hesitated to offer a rule-of-thumb line on anything because so many factors were involved. As a generalization, with total machine polishing, runs of 5,000 would be required, because the question of the changeover of work holders had to be considered. With shorter runs he would suggest a semi-automatic machine. There were, however, many factors which forced a man into a decision whether to turn to full automation or semi-automatic machines. For instance, how much could be done by semi-automatic means first on smaller quantities? How much would be done with one unit? Or must there be a combination of un.ts?

A polishing machine need not cost £20,000 or £30,000. A machine of that kind was the exception rather than the rule. It was possible to buy a machine which would do a lot of work for much less than that.

MR. DEWAR said that the use of man-made materials in everyday wear was creating a problem. It was necessary to ensure that no Nylon or Terylene got into ordinary mops made from shirting.

MR. GOODWIN said that the discussion on man-made fibres had concentrated on the use of woven man-made fibres. It should be pointed out that man-made fibres, including Nylon, were already used in the polishing industry. For instance, foam spun Nylon was readily available in America and was becoming available here. The cooling effect was achieved by the spinning and foaming. The result was a disc looking as though it had been cut from candy-floss.

The attempt had been made to include the abrasive material—aluminium oxide or silicon carbide—in the manufacture of the material. In the discussion it was important to differentiate between man-made fibres in a conventional weave and the new material which would bring a great benefit. The main application of the new material at the moment was for the fine satin finishes, but the uses would be extended.

MR. DEWAR replied that he had seen the material in question. He wished to reserve his comments about it because when Mr. Davis had asked about man-made fibres he had been thinking of strenuous polishing operations in which an appreciable amount of heat was generated. Mr. Goodwin was thinking of a woven nylon web, impregnated with an abrasive. He was prepared to believe that for light operations, such as a satin finish, this material might have an application, but he had come to the conclusion that when he had tried the nylon web he had applied far too much pressure. In fact, it had not been more pressure than would be used in practice ; had he been trying to obtain a satin finish with a mop and a greaseless composition he would have applied no more pressure. Nevertheless it was an interesting development and perhaps he had been putting it to an unfair test.

MR. W. H. HALL said that his Company operated a relatively small polishing and plating shop, the remainder dealing with die casting. He agreed with everything that had been said about the quality of products for finishing. If they tried to improve a die casting to the quality which was really required it was necessary to reduce the number of impressions from a mould, and this increased the casting costs considerably. This was a problem when dealing with the non-technical buyer who thought only of cost and not of quality. With articles which his company were producing for themselves, it was found well worthwhile to spend extra money on the dies, achieving a higher standard of finish and accepting the higher casting costs and the reduced number of impressions, because money was saved in the finishing stage ; but when trying to sell more expensive die-castings to other customers they would not pay the price.

MR. BRYAN said he appreciated that the die casters had to face this problem of price. The finishers had to remove defects, and that often involved applying much pressure over the rest of the job. If the casters could leave the edges a little finer, it would help considerably.

ABSTRACT

SOME ASPECTS OF THE USE OF LIQUID POLISHING COMPOUNDS

*S. J. Scouse**

FOR convenience polishing operations can be divided into the following groups : cutting ; glazing ; polishing and colouring. In practice, however, each group overlaps to some extent. Liquid polishing compounds are available for the last three groups and consist normally of an O/W emulsion of fat, wax or fatty acids in which the appropriate abrasive is suspended. For the first group (cutting) it appears that a resin emulsion is required to anchor the abrasive to the cutting mop. The question of suspending the abrasive in the liquid phase is of great importance if the liquid compound is to be successful.

* *Henry W. Peabody (Industrial) Ltd.*

As a result of experiments with various methods of applying the compounds it was decided to employ a conventional air atomizing spray gun of robust construction. The gun should be designed so that it can be cleaned without difficulty and provision should be made so that the hose connexions are large enough not to impede the flow of the comparatively viscous polishing compound. The author also prefers a gun in which some compressed air passes even when compound is not being atomized. In addition, the degree of atomization should be able to be varied easily and the spray width should also be variable.

A further important factor is the control of the total quantity of compound used each minute or for each component. Thus a timing device is required to control (a) the duration for which the compound is applied and (b) the moment during the polishing cycle at which application of the compound starts. The timer should operate only when the polishing machine is in operation.

Compound can be applied to the " bite " formed between the mop and the article, radially to the mop surface above the point of contact, almost radially to the mop surface on the side remote from the polishing point and almost tangentially to the mop surface and against the direction of rotation of the mop. All these methods have their relative advantages and disadvantages.

The use of liquid compositions for hand lathes has been considered but in the author's opinion is not, at the present time, a practical proposition.

All liquid compounds tend to dry out and form a skin when exposed to air and so should be kept in closed containers. Blocked hoses can be more of a nuisance than a blocked gun.

A successful method for storing compound is to pack it in polythene bags inside the transport container. The liner keeps the contents free from contamination and, when the contents are nearly used, the liner can be lifted from the drum and the remaining compound squeezed into the pressure pot. Another approach is to provide containers that can be placed straight into the pressure pot without pouring out the contents.

The viscosity of liquid polishing compounds is affected by changes in temperature which should therefore be kept as constant as possible and also stocks of compound should be used in rotation to avoid excessive storage times. The abrasive in a liquid compound should not settle out during normal storage so stirring before use is not necessary. Thinning of compounds with water is not recommended.

When the polishing machine stops work the compound supply to the spray gun should be turned off at the pressure pot so that the fluid line remains filled with compound. On large installations a pump feed may be more suitable than a pressure pot.

Liquid compounds are now available at prices close to those of bar compounds, and in general the consumption of a liquid compound for a given number of articles is less than that of bar compounds.

Figures quoted give savings in the range of 25 to 66 per cent. The cost of the equipment for applying liquid compositions is, in the author's opinion, less than that for supplying mechanical applications for bar compounds, and maintenance of spray guns is also less than the mechanical equipment.

The use of liquid compounds also reduces mop wear, facilitates cleaning operations, and reduces idle machine time.

Liquid compounds are also advantageous when using wide faced mops and, the author claims, are superior to bar compounds on mops rotating at low speeds.

DISCUSSION

MR. GOODWIN said that his company had been using the liquid polishing method for a considerable time, and he wished to dispel any idea that the use of liquid compounds by the present orthodox method of the spray gun would result in a mess on and around the polishing machine and in the polishing shop. In fact, his polishing shop was cleaner than before.

It had been found possible to polish some awkward shapes, although in their production they had a requirement that the work must be left free of polishing compound ; by the hand-polishing method and by automatic polishing, using bar compositions, this condition had been difficult to obtain and it had been necessary to carry out degreasing operations. With the liquid polishing compound, on the other hand, there was no overspray at all on certain unshielded areas. It was possible to do a better job using a liquid, than ever before.

He disagreed with the author's decision to make a cost comparison on a basis of weight for weight for the material. The only thing in which users were interested was the material cost in producing x number of articles. His own experience was that it was possible to make savings and in his own organization these had been 28 to 30 per cent, brought about mainly by a reduction in machine idle time for composition changes and a great diminution in mop wear. It should be realized that if the work was properly controlled and only the amount of compound required to do a given operation and no more applied, then the necessity for the old-fashioned method of raking out the mop was reduced. Raking out in itself caused considerable wear ; in fact, probably 50 per cent

of the mop was worn away by this process ! There were also the savings in subsequent degreasing operations, as he had indicated.

Insurance Reductions for Liquid Polishing

Another point to be borne in mind was the possible reduction in insurance rates due to the elimination of the fire hazard. Some of these new materials had a very high flash point and were virtually free of fire risk, and a considerable saving could be made on the insurance premium.

Turning to capital investment, he said that whereas for mechanical application of bar compositions it was necessary to have one applicator set up for each polishing mop, considerable capital investment economies could be achieved in liquid composition by having one pressure pot or pump feeding a number of guns.

As regards the cost of materials, it should be borne in mind that the important point about a liquid composition was the percentage of cutting media present compared with the percentage of water. Water was comparatively cheap but cutting media were not ! Consequently, a statement of price per lb. or per gallon was not the only thing that mattered in liquid polishing costs.

Mr. Williams earlier had spoken about a scientific approach and had emphasized the difference in this respect between plating shop operatives and polishing shop operatives. There was no doubt that in future, with liquid polishing and mechanical polishing, it would be necessary to have a great deal of co-operation between plant and process engineers in the factories and organizations and between the polishing and production personnel. In future there would be reference to such terms as dehydration rates, viscosities, stable emulsions, peripheral speeds, and so on. In respect of peripheral speeds he disagreed with Mr. Bryan ; these speeds would be a matter for discussion. They would also discuss such matters as pipeline resistance and spray distances.

Little mention had been made of the gun movers for moving over wide mops such as were available on the universal, flexible type machines. These new types of mop and new methods of designing the work under the mop were already in the industry But some of the methods of moving the spray guns which he had seen in this country and in the United States were not very efficient. Consequently, his organization had been compelled to devise its own method. For instance, with a mop 3 to 4 ft. wide there was a considerable time of traverse from one end of the mop to the other. By using what he called the wet-on-wet application, they were spraying from one end to the other and the condition in the centre was totally different from that of the two extremes. His company had therefore made the stroke-time independently variable of both forward and return strokes, using a very slow forward traverse, spraying all the time and a very rapid return. This meant that spraying was in one direction only, returning to the beginning and spraying again. The time lapse between the spray and return at any one point was identical with that at any other point. In his opinion this method would be very important,

Liquid Compounds for Hand Operation

The author had dismissed briefly the possible use of liquid compositions in hand operations. Admittedly there were difficulties, one being the application of the correct amount at the correct time. Mr. Goodwin said he was experimenting with a method which showed some promise, linking a spray gun with an electronic device.

A new new liquid polishing technique had been tried in Europe and was in production in the United States, and by this technique it was possible to dispense with the conventional mop and spindle. The work was immersed into a drum of polishing media and was moved around at very high rates.

MR. F. W. ANDERSON said the glue-based liquid compositions, using the term in a broad sense, were available in Britain. Unfortunately, a suitable gun was not available, but it would be in the near future. The author had said that he did not always recommend the use of a preservative, but after about three months, Mr. Anderson said, the compound could go rancid without one. What did the author consider the retention percentage of a given liquid compound, *i.e.* the percentage of the compound spread on the revolving buff which remained on it, as opposed to the amount thrown off, without any work coming into contact with the wheel ? Second, what did he consider to be the head build-up of a given liquid compound, *i.e.* the increasing weight on the buff during a definite number of cycles during which a sheet of metal under pressure was applied to the base of the revolving buff !

MR. SCOUSE replied that if Mr. Anderson knew the answers to those questions, it would be interesting to hear them, as so far he had not looked into them scientifically.

Mr. Goodwin had criticised the Paper for making a weight-for-weight comparison. Unfortunately, in the average polishing shop that was the only comparison which could be made.

Cooling with Diluted Liquid Compositions

MR. HATCH asked whether the author had any experience of using a diluted liquid composition as a coolant, and using an increased mop size and thus a higher peripheral speed ?

He agreed with Mr. Anderson that greaseless compounds were available in this country and were being used successfully. A nickel finish had been

developed but it was not quite as good as the standard finish.

MR. SCOUSE said he thought that if the mop speed were reduced, there was better coverage. Increasing mop speed would increase the amount of throw-off and therefore decrease the retention. He could not understand how Mr. Hatch could polish with such large quantities of water present. Did he rely on the water evaporating and on the evaporation cooling the job ? In that event, surely there would be difficulty in establishing a suitable and stable heat balance between the quantity required to cool a very hot article, on the one hand, and the small amount of compound which was economically necessary, on the other hand.

MR. HATCH said it was possible to use a very liquid composition with a high percentage of abrasive. He was thinking of percentages of 60 per cent, abrasive and 20 per cent water.

MR. E. A. OLDFIELD also wondered why so little was known about abrasive operations ! It was noticeable, for instance, that the only reference to surface finish was contained in the Paper on electro- and chemical polishing, which were closely allied to the electro-plating trade. Great ingenuity had been applied to the application of compositions to wheels and to the mechanization of the process, but little was known about what was going on.

Two of the most significant things to measure were the surface finish — and there were excellent machines for doing this — and the amount of metal removed. The abrasive industry, however, was in the Middle Ages in its scientific knowledge — probably the same stage as that of the metallurgical industry 100 years ago. It was in the early days of the application of science that the greatest economic savings resulted, and if only a very small fraction of the money spent on developing machinery were spent on basic research, the dividends and economic savings would be very high.

As an example, the Cutlery Research Council, in a very modest way, had started doing work of this nature. They had tried to investigate the effect of the amount of grease. First, a wheel with grease applied had been tried and allowed to run dry, and the rate of metal removal had been about 1 unit/minute. Grease had then been applied — the comparison was between a little grease and a lot of grease — and it had been found that the surface finish resulting from the addition of more grease was hardly changed but that the rate of removal rose forty times.

Had any trials been conducted in making use of centrifugal force by applying the abrasives or the abrasive compound through the wheel itself ?

MR. SCOUSE replied that he had considered the application of the composition through the hub but it had been considered that any abrasive would be filtered out. This would mean that a liquid phase would reach the mop surface, and the mop would ultimately be loaded with abrasive.

Effect of Grease on Metal Removal

He was very interested in the observations in connection with the effect of the amount of grease on metal removal. He had found that altering the type of grease or fat which was emulsified and altering the ratio of fat to abrasive had more bearing on the results than had an alteration in the type of abrasive. With bar compounds, the types of fat which could be used were prescribed. They must be comparatively cheap and have a fairly high melting point. With the liquid compounds. however, in effect it was possible to use some of the fatty acids which were liquid at room temperature

DR. B. A. SCOTT drew attention to a recent German patent wet polishing, for particular use with aluminium. The method involved polishing with a liquid stream of alumina suspended in a soap solution and using a wheel of micro-porous rubber. The inventors claimed that the best surface finish was obtained when the polishing action was largely the removal of metal rather than smearing over the form of detritus layer. They had given measurements of reflectivity using this method of polishing alone and comparing it with chemical and electrolytic polishing. These showed remarkable high figures for the reflectivity of tin. Apparently the method employed a liquid stream flowing over the work during the polishing process.

The author had spoken of the wear of mops. What life did he obtain for the jets of the spray gun, pumping an abrasive through them at a relatively high speed ?

MR. SCOUSE replied that he was very interested in the news about the German patent. Mr. Goodwin had mentioned a slurry polishing operation. As a matter of interest, the author's entry into the problems of liquid polishing had stemmed from activities in one of those polishing operations in which the parts were, in effect, immersed in the polishing compound and abraded under the surface of the compound. Many limitations arose, however, when such aprocess was put on production line.

It was true that spray jets wore out, but in his opinion the mortality of spray jets was more dependent on the size of the nail which the operator used to clear the jet than on the erosion effect of the work !

MR. DEWAR said the speakers from the Cutlery Research Department had rightly mentioned the absence of technical terms in polishing. There was also an absence of manufacturers claiming that they must have a certain standard of surface

(*Continued in page* 460)

ZINC COATINGS ON IRON AND STEEL

3 – Corrosion Resistance of Zinc Coatings

A Survey

by A. K. PARKER, M.A.
in collaboration with the Zinc Development Association

(*Continued from page 325, September 1959 issue*)

IN Chapter 1 the nature of corrosion and the way in which zinc coatings protect steel from rusting was considered briefly. In this chapter the question of corrosion will be dealt with quantitatively and the variation in the useful life of zinc coatings with the environment to which they are exposed, assessed.

During the past twenty years, the corrosion resistance of metallic and paint coatings has been examined in extensive series of tests in which carefully prepared specimens are exposed to the atmosphere, immersed in sea water or buried underground for several years. Inspections have been made regularly and the amount of corrosion assessed in terms of the loss in weight of the coating, its superficial appearance and the amount and depth of pitting. Such field tests, carried out under actual service conditions, have been supplemented by laboratory tests using artificial means of simulating and concentrating the effect of one or more of the individual corrosive influences likely to be met with in service.

ATMOSPHERIC CORROSION

The behaviour of zinc and zinc coatings on atmospheric exposure has been examined closely in tests carried out throughout the world and the likely performance in a particular atmospheric environment can now be predicted within reasonable limits.

In dry air, zinc is slowly attacked by atmospheric oxygen. A thin dense layer of oxide is formed on the surface of the zinc and a porous outer layer then forms on top of it. Although the outer layer breaks away from time to time, the thin under layer remains and protects the metal by restricting its interaction with the oxygen.[1] Under these conditions, which occur in some inland tropical climates, the zinc is oxidized extremely slowly.

In coastal districts and industrial areas, the air is contaminated with water containing considerable amounts of dissolved salts. Sodium chloride is, of course, the main salt present in marine atmospheres and oxides of sulphur are the most important pollutants in industrial and urban atmospheres.

Fig. 16.—*Field test exposure rack*
(Courtesy of British Iron and Steel Research Association)

The oxides of sulphur dissolve in water to form sulphuric acid which in turn reacts with the zinc hydroxide or zinc carbonate formed on the zinc surface to give zinc sulphate. This salt is very soluble and so is easily removed by rainwater, leaving the zinc surface relatively unprotected. This solubility of the zinc corrosion products is one of the most important factors affecting the rate of corrosion of zinc in industrial atmospheres and largely accounts for the fact that this rate may be as much as 4 or 5 times greater than that in rural or marine atmospheres, depending on the amount of sulphur present.

If a fresh zinc surface is allowed to stand with large drops of dew on it, as may easily happen if it is stored in a closed space in which the temperature varies periodically, it is attacked by the oxygen dissolved in the drops of water. These drops of water conduct electricity slightly and, because the oxygen concentration is greater at the outer edges of the drops than at their centres, some electrochemical action results. Thus bulky deposits of porous zinc oxide or hydroxide form on the surface instead of forming a protective layer all over it. This oxide quickly takes up carbon dioxide to form a basic carbonate, commonly known as "white rust." This may form on any new zinc surface, unless care is taken to store the metal in a dry, airy place until the protective layer has formed over the whole surface. The formation of white rust may also be prevented by a simple chemical treatment of the type described in Chapter 4.

Table 1

Site	Type of Atmosphere	Exposure for 5-years			Estimated life of 2 oz. per sq. ft. zinc coating*
		Corrosion rate mils/year		Ratio Ingot Iron to Zinc	
		Ingot Iron	Zinc		
Llanwrtyd Wells	Rural	2.2	0.09	24	34
Calshot, Hants	Marine	4.5	0.13	34	23
Motherwell, Scotland	Industrial	2.4	0.18	13	17
Woolwich, Kent	"	2.7	0.16	17	19
Sheffield (University)	"	3.4	0.20	17	15
Sheffield (Attercliffe)	"	4.7	0.60	8	5
Dove Holes Tunnel	Railway tunnel (steam)	2.5	2.9	0.8	1
Khartoum, Sudan	Dry, Tropical	0.0	0.01	—	300
Abisko, N. Sweden	Sub-polar	0.1	0.01	10	300
Aro, Nigeria	Inland tropical	0.3	0.02	15	160
Basrah, Iraq	Dry, sub-tropical	0.3	0.01	30	300
Singapore	Marine tropical	0.4	0.03	13	100
Apapa, Nigeria	" "	0.8	0.03	27	100
Congella, Durban	Marine Industrial	3.0	0.18	17	17

*These lives have been calculated on the assumption that 10% of the original zinc remains when rusting of the basis steel begins, which Gilbert[3] found to be true for coatings of reasonable uniformity.

Atmospheric Exposure Tests on Zinc

These different corrosion mechanisms all play their part in determining the rate of corrosion in a particular environment. A quantitative assessment of the relative corrosiveness of different atmospheres can be seen from the results of the exposure tests reported by Hudson and Stanners, working for the British Iron and Steel Research Association.[2] (Table 1).

It will be seen that, while neither iron nor zinc corrodes appreciably in the dry tropical climate of the Sudan, the atmosphere at the Attercliffe site in Sheffield appears to be about sixty times as corrosive to these metals. Corrosiveness can vary appreciably over very short distances as a comparison of the figures for the two Sheffield sites shows—although these are only a few miles apart, the corrosion rate for zinc at the Attercliffe site is roughly three times that at the University site. Conditions in Dove Holes railway tunnel are extreme—the very damp atmosphere being saturated with sulphurous smoke from the locomotives—and under such conditions, zinc coating serves no useful purpose.

Under all other conditions of outdoor exposure the corrosion rate of zinc is many times less than that of ingot iron, the ratio being highest in rural and marine atmospheres and lowest at the more corrosive of the two Sheffield sites. Even here however the ratio is sufficiently high to make zinc coating economically worthwhile when all maintenance costs over a period of, say, 50 years are taken into account.[4]

So far, the rates of corrosion of sheet zinc in different atmospheres have been considered and compared with those of ingot iron. Measurements of the corrosion rates of zinc and zinc coatings have been made simultaneously in many parts of the world and it has been found that the rates are substantially the same, so the same figures can be used to calculate the estimated lives of zinc coatings of a given weight, exposed in a particular environment. The results of such calculations are quoted in the right-hand columns of Tables I and IV.

In making these estimates, it has been assumed that only 10 per cent. of the original zinc remains

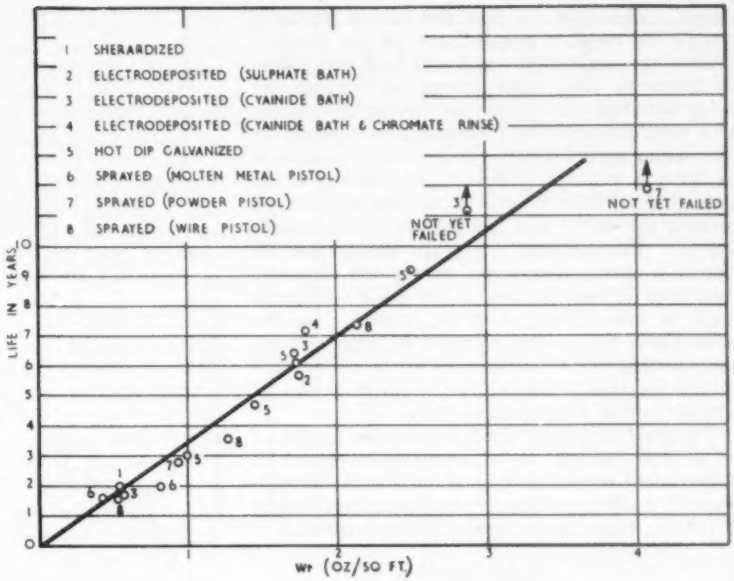

Fig. 17.—Results of exposure tests at Sheffield.

when rusting of the basis steel begins, which Gilbert[8] found to be true in exposure tests on galvanized coatings carried out in the Euston area of London.

The question of what constitutes failure of a zinc coating is an important one. Generally, the underlying ferrous metal is protected so long as it is able to fulfil its designer's intentions. Thus, a galvanized roof has not failed so long as it keeps rain out of a building, nor a farm fence so long as its strands are strong enough to keep animals from straying. However, in other applications, slight discoloration of the surface may be unacceptable, even though the zinc layer is still intact over the article.

In exposure tests on zinc coatings, it is usual to define failure as the appearance of rust over a certain fraction of the surface, *e.g.* Hudson has chosen 5 per cent. rust on the surface as his criteron of failure in the tests discussed below. Other workers have taken 10 per cent. or more as their criterion.

Atmospheric Exposure Tests on Zinc Coatings

The behaviour of zinc coatings, of different thicknesses and applied by different methods, has been examined in tests under actual outdoor service conditions. One of the most extensive series of such tests is that being carried out for the British Iron and Steel Research Association by Hudson and his co-workers.[6] In these, specimens of steel carrying hot dip galvanized, sherardized, zinc plated and zinc sprayed coatings have been exposed at five sites—three in Great Britain and two in Africa (*see* Table II).

Table II—Exposure sites

Site	Climate
Sheffield	Highly polluted industrial
Llanwrtyd Wells	Rural with heavy saline rainfall
Calshot	Marine
Congella (Near Durban)	Marine
Apapa (Near Lagos)	Tropical marine

Just because zinc has such good corrosion resistance, it takes many years of exposure in all except the most corrosive atmospheres to obtain any useful results. The tests at Llanwrtyd Wells, Calshot, Congella and Apapa are therefore still in progress and by 1956 only one specimen had been reported as having failed (the thinnest one at Calshot, a sherardized coating of 0.49 oz. per sq. ft. zinc failed, according to Hudson's definition, after 8.8 years exposure).

Very full results are however available from the tests at Sheffield where the atmosphere is highly polluted with sulphurous and other industrial fumes. The behaviour of the individual specimens is plotted on the graph (Fig. 17), in which the axes give the weight of coating and the number of years to failure.

It will be noticed immediately that a straight line can be drawn through or very close to all the

points. This tells us that the life of the zinc coating is roughly proportional to its weight.* This is very important result which should always be borne in mind when protective coatings are being specified for a particular service application. If a steel structure or component is expected to have a long service life, it is always more economical to apply a sufficiently heavy zinc coating at the start than to have to renew the coating later on because the initial zinc coating was of inadequate weight. The amount of surface preparation required is nearly always less with a new structure than with an old one and is the same whether a thick or thin coating is to be applied. On the other hand, there is no point in applying a heavy zinc coating to something which is to be discarded for other reasons after a short period of service in mildy corrosive conditions.

The graph also shows that the corrosion resistance of a zinc coating on atmospheric exposure is independent of the method of application, though there is a different limit to the maximum weight of coating which can be applied by each method.

Table III

Method of application	Approx. maximum weight of coating which can be applied
Hot dip galvanizing	2 to 3 oz. per sq. ft. of surface
Zinc plating	1 to 2 oz. per sq ft.* "
Sherardizing	1 oz. per sq. ft. "
Zinc spraying	No theoretical limit but usually 8 to 10 oz. per sq. ft. "

*Though heavier zinc coatings can be deposited from cyanide baths, extremely careful control is necessary and the limit suggested here is that obtainable under normal factory conditions.

Similar results have been obtained in the very comprehensive series of tests carried out in the United States by the American Society for Testing Materials. Zinc-coated wires and sheets have been exposed for periods of up to 17 years and the average corrosion rates are shown in Table IV.(6)

Table IV

Site	Climate	Avg. Corrosion rate of zinc (oz. per year)	Life of a 2-oz. coating
Pittsburgh, Pa.	Severe industrial	0 34	5 years
Sandy Hook, N.J.	Marine (300yds. from ocean)	0.13	14 "
Bridgeport, Conn.	Industrial	0.13	14 "
State College, Pa.	Rural	0.06	30 "
Lafayette, Ind.	Rural	0.07	25 "
Ithaca, N.Y.	Rural	0.06	30 "
Ames, Iowa	Rural	0.04	45 "

Another important result has been brought out by a series of tests undertaken by the Swedish Committee on Corrosion.(7) They found that a zinc-coated surface is much less liable to suffer pitting attack than is unprotected steel. The depth

*There is however some evidence that the corrosion rate of zinc coatings exposed to marine atmospheres falls off slightly on account of the formation of protective films.

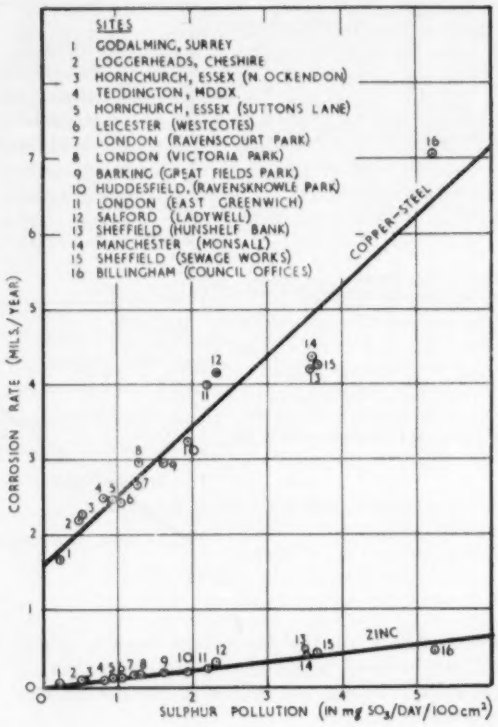

Fig. 18.—Effect of sulphur pollution on the corrosion rates of zinc and copper bearing steel.

of pits on unprotected steel was up to six times the average loss of metal while in the case of zinc-coated steel, the ratio was only two or three.

Zinc-rich paints have been excluded from this discussion because, as they have only been developed within the past few years, there are no long term test data about them, comparable with what is available for the older zinc coating methods.

Sulphur Pollution and the Corrosion Rate of Zinc

It is already apparent from the discussion that the sulphur content of the atmosphere plays a major part in determining its corrosiveness towards both iron and zinc. Hudson and Stanners(2) carried out a series of exposure tests on specimens of zinc and of a steel containing 0.2 to 0.3 per cent. copper at sixteen sites in the United Kingdom at which the sulphur pollution of the atmospheres was also measured. Their results are shown graphically in Fig. 18.

From these results, the authors concluded that "the correlation between sulphur pollution and corrosion is high, both for copper-steel and zinc.

This demonstrates beyond question that the sulphur dioxide concentration in the air is the determining factor for the intensity of the corrosion of these metals in Great Britain." Nor did they find any substantial difference in the corrosion rates of zinc if the specimens were exposed for periods of one or five years.

By comparing the slopes of the two straight lines on the graph, it seems reasonable to deduce that the ratio of the corrosion rates of copper-steel and zinc due to sulphur pollution alone is somewhere in the region of nine. In practice the figure is often higher than this (*see* Table I) on account of other factors, while in the extremely severe conditions met with in steam railway tunnels, in anti-glare structures over pig-beds, coke-ovens etc. the ratio can be considerably less than nine.

In another series of tests carried out by Clarke and Bradshaw,[8] it was found that even at test sites situated as far from industrial towns as Trevose (North Cornwall) and Christchurch (Hants.), the corrosion products contained a strong sulphate-component derived from atmospheric sulphur compounds, which indicates that the effects of this type of pollution are very far-reaching.

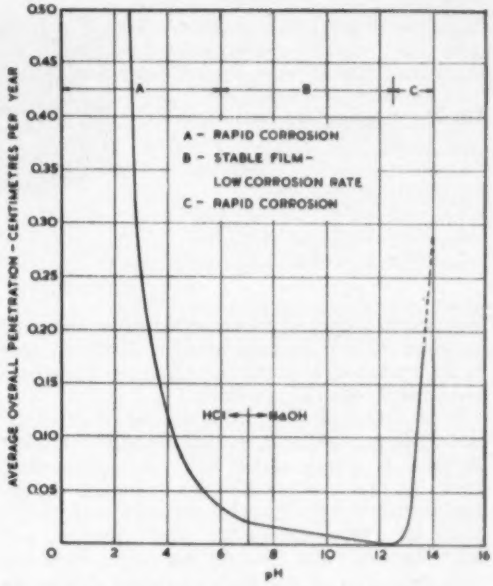

Fig. 19.—Effect of pH on the rate of corrosion of zinc.

Other Factors Affecting the Atmospheric Corrosion of Zinc Coatings

Gilbert[3] has investigated the effect of impurities in the coating on its life. He found that the incorporation of up to 3 per cent. aluminium, 3 per cent. tin, 1 per cent. antimony or 10 per cent. cadmium in hot-dip galvanized coatings had no recognizable effect on their corrosion resistance.

The uniformity of the coating is, of course, an important factor in determining its service life. Unless it is spread uniformly over the basis metal, the zinc cannot do its work properly and much of it may be wasted if a sheet has to be discarded as soon as a part of the iron or steel is exposed to such an extent that it can no longer be protected sacrificially, while the rest of sheet is still well covered. It follows that small local deviations from uniformity are less important with a thick coating than with a thin one. Gilbert[3] found that, with coatings of the order of 2 oz. per sq. ft. and of reasonable uniformity, less than 10 per cent. of the original zinc remained when rusting of the basis steel began, whereas if the coating was very uneven as much as 50 per cent. of the zinc might still be present when rusting began.

Corrosion tests have also shown that there is a marked difference in the rates of corrosion throughout the year. This is partly because the sulphur content of the air is greater in Winter than Summer and partly because more of the zinc corrosion products are dissolved under the wetter Winter conditions. Thus, it follows that some advantage will be gained if unpainted zinc coatings are first exposed to the atmosphere in the Spring or early Summer as this will give the protective film a better chance to build up and do its important work.

Some information has been published on the performance of zinc coatings inside factories, where they are subject to attack by industrial gases and fumes. Zinc-coated steelwork seems to stand up well to conditions in galvanizing shops, where acid fumes from pickling tanks give rise to severe conditions. The good performance of zinc-sprayed steelwork adjacent to chlorine and hydrogen chloride plants has also been reported.[9] Extensive trials[10] in other chemical plants have shown that zinc-sprayed coatings performed outstandingly well, both when used alone and when used as the basis of a protective system incorporating auxiliary paint coatings, in a wide variety of corrosive conditions. In one test with ammonium sulphate as the main corrodent, unpainted zinc coatings showed no sign of rust after 4-years exposure while other protective systems failed within one year.

LIQUID CORROSION

So far the corrosion resistance of zinc has been considered only when it is exposed to the atmosphere or to industrial gases. In many applications, zinc-coated steel is used in contact with liquids, when a different set of conditions determine its corrosion resistance. The degree of acidity or alkalinity is the factor of greatest

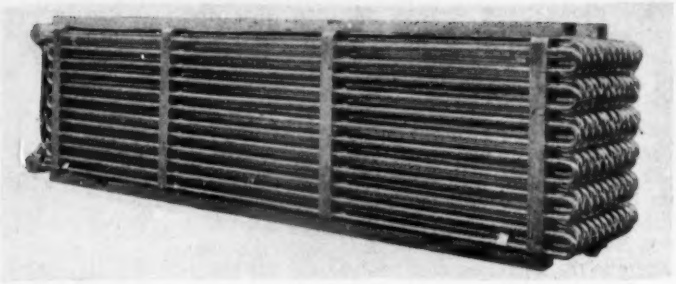

Fig. 20.—A galvanized refrigerating coil.
(Courtesy of Zinc Development Association)

importance ; this is most conveniently measured in terms of the concentration of hydrogen ions in the liquid and is usually expressed on a logarithmic scale as the *p*H number.

From the graph (Fig. 19) it will be seen that the zinc coating dissolves in liquids whose *p*H is below about 6 or above about 12.5. At intermediate values of *p*H, a protective film is formed on the zinc surface and the zinc corrodes only very slowly. Since all alkalis, except the very strongest, and most types of water fall into this range, there is a very wide field of use for zinc-coated steel in the storing and conveying of liquids.

Separate sections are devoted to the corrosion-resistance of zinc in contact with fresh water and sea water, so the discussion here will be confined to its behaviour in contact with chemicals and foodstuffs. Most organic liquids, other than the stronger acids, or substances likely to contain them, such as aldehydes, attack zinc only slightly so that it is suitable for storage tanks and equipment used in contact with motor fuels, creosote and phenols, trichlorethylene degreasing solutions, esters etc. Zinc-coated steel is often used for the working parts of refrigerating equipment as it is highly resistant to corrosion by the refrigerants, which often consist of alkaline solutions of calcium chloride. (Fig. 20).

Zinc-coated vessels are not recommended for prolonged use in contact with foodstuffs. A certain amount of zinc is an essential constituent of the human body and the small amount picked up from galvanized water pipes is perfectly safe. Excessive amounts are however harmful and so zinc-coated steel is unsuitable for eating or cooking vessels or for storing liquid foodstuffs, many of which are acid or develop acidity, like milk. It is quite satisfactory for storing dry foodstuffs and for troughs intended to hold dry feeding stuffs for animals. (Fig. 21).

Wet cement also attacks zinc, but once it has set there is no further interaction.[11] High-alumina cement does not attack zinc, even while it is wet.

Fresh Water

As in the atmosphere, so in water, the corrosion resistance of a zinc coating depends on its initial ability to form a protective layer by reacting with the environment. In distilled water, which cannot form a protective scale to reduce the access of oxygen to the zinc surface, the attack is more severe than in most types of domestic or river water, which do contain some scale-forming salts.

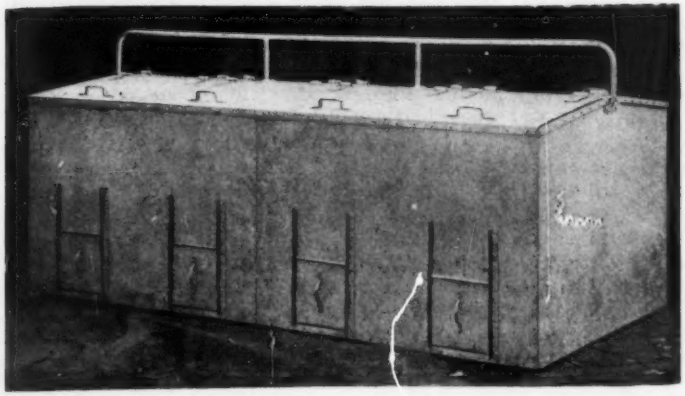

Fig. 21.—Galvanized bin for corn and dry feeding stuffs.
(Courtesy of Zinc Development Association)

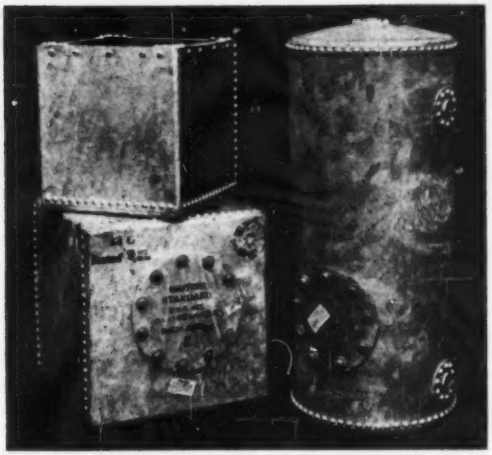

Fig. 22.—Galvanized water tanks.
(Courtesy of Zinc Development Association)

In general it is found that the softer waters, with their higher content of dissolved oxygen and carbon dioxide, attack zinc more vigorously than the fairly hard waters which are commonly used for domestic purposes in Great Britain. River waters have been found to deposit scale more easily than well-waters.[12]

Hot-dip galvanized tanks, cisterns and piping are very widely used for storing and carrying domestic water in buildings throughout the world. (Fig. 22) As a rule such equipment gives long and trouble-free service, but occasionally tanks and pipes fail within a short period after their installation. In such cases, it is nearly always found that failure has occurred because something prevented the formation of a protective scale rather than because of any defect in the zinc coating. The conditions under which this may happen will now be examined, cold- and hot-water systems being treated separately.

Failure in Cold-water Systems

If the water is too soft, as is the case in a few districts only, it may not contain enough of the scale-forming salts to form a protective layer. *

The scale-forming ability of water depends principally on three factors : the hydrogen-ion concentration (*p*H value), the total calcium content and the total alkalinity. If the *p*H value is below that at which the water would be in equilibrium with calcium carbonate, the water will tend to dissolve rather than to deposit scale. Waters with a high content of free carbon dioxide also tend to be aggressive towards zinc.

*This may also apply when rainwater is stored in galvanized tanks. Tests in Australia have shown that the immersion of a small gauze tube containing glassy metaphosphates assists the formation of a protective film in rainwater without contaminating it in any way.[21]

If, when the tank is installed, drillings and other odd bits of steel or other metal are left in the tank, there is electrochemical action between them and the zinc, the zinc dissolving sacrificially to protect the worthless pieces of uncoated steel instead of the tank which it was intended to protect. All tanks and pipes should therefore be cleaned out thoroughly before being filled and it is often advisable to cover over the open tops of tanks to prevent rubbish finding its way into them later on. Inert matter will also interfere with the formation of the scale if it is left in it when the tank is installed.

Especial care needs to be taken if copper plumbing is used in conjunction with galvanized steel pipes and tanks.[14] This is because some waters dissolve minute amounts of copper and plate it out on the galvanized steel, forming tiny electrolytic cells. Such cells operate in the same way as the ordinary Daniell cell, with rapid corrosion of the zinc. If the water in a district is not cuprosolvent, then the use of copper and galvanized steel in the same cold water system will not lead to premature failures ; the possibility of back diffusion of copper-contaminated water from the hot-water systems should be watched for carefully. Previous experience in the ditrict is the best guide to likely performance of these ' mixed systems.'

In aggressive waters, it is often advisable to coat the inside of the tank with two coats of a non-tainting bituminous paint when the tank is installed. This is perhaps most important when a replacement tank is being installed in an existing cold-water system. In such cases, the corrosive attack is initially concentrated on the new tank because the remainder of the system is protected by scale laid down previously, and the formation of a protective layer on the new tank is delayed.

Hot-water Systems

The mechanism of corrosion of zinc in hot domestic water is different from that in cold and there is a slightly greater risk of premature failure of galvanized tanks, if insufficient care is taken when they are installed. The need to clean the tank out thoroughly before it is filled is even greater in hot water than in cold. ' Mixed ' systems containing both copper and galvanized steel components should be avoided altogether because all waters will dissolve enough copper to be dangerous to zinc at the temperature of ordinary hot-water systems.

Above about 60°C (140°F), zinc becomes cathodic to iron and no longer provides sacrificial protection to the underlying metal at breaks in the coating. Zinc behaves at such breaks as nickel and tin coatings do at room temperature (*see Chap. I*) ; there is rapid attack on the steel and pitting results. However, if a layer of scale has already formed, it

will protect the tank against this sort of attack. It is most important therefore that the tank should not be overheated during the vital scale-forming period, that is the first 6 to 12 months of service. Overheating after this time is not advisable though it is not likely to be so dangerous as when the tank is first installed. One common cause of persistent overheating is the use of too small a storage tank—sometimes a larger boiler has been installed to cope with increased demands for hot water and the tank has not been replaced at the same time. Where thermostatic control is installed, overheating is only possible if the control is set at too high a temperature.

So far, no satisfactory paint systems have been developed for protecting the insides of hot-water tanks. Experimental use of magnesium anodes to give cathodic protection to the zinc has shown considerable promise. Magnesium is below zinc in the galvanic series (*see Chap. I*) and so corrodes preferentially if both are in contact through a conducting liquid ; for such anodes to be effective it is essential, of course, that the water should have good electrical conductivity. The anodes are found to have a life of about five years in most hard waters and so will protect the tank during the whole of the vital scale-forming period. Their use is not recommended in soft waters.

Conclusions

In this section, the conditions which may lead to premature failure of galvanized tanks and cisterns and ways of avoiding them have been discussed at some length. In the great majority of cases, and there must be many millions in Great Britain alone, no trouble is experienced and it is only the few exceptional cases which are reported in the Press. Of course, no tank will last for ever and it would be too much to expect every tank to give more than 20 to 30 years service, though, under favourable conditions, many do last considerably longer than this.

Sea Water and Salt Spray

The frequency with which seaside piers and ship's hulls require repainting testifies to the corrosiveness of sea water and the importance of taking adequate protective measures. The salts present in the North Sea amount to about 3.5 per cent. of the total, mainly sodium chloride with smaller amounts of magnesium and calcium salts, giving a solution with a *p*H of about 8.

The corrosion resistance of zinc compares very favourably with that of other coating materials when totally immersed in sea-water, possibly on account of the slightly inhibitive action of the magnesium salts present.[15] In tests at Gosport, the British Iron and Steel Research Association immersed aluminium-, cadmium-, lead-, tin- and zinc-coated specimens for two years. All except the zinc-coated specimens failed in this time.[16] The zinc-coated specimens were then transferred to Emsworth and immersed for a further 4 years. At the end of this time — a total of 6 years immersion — the 3-oz. per sq. ft. coatings were just ceasing to give complete protection to the basis steel. The experimenters therefore concluded that the consumption of zinc is roughly 0.5 oz. per sq. ft. of steel surface protected per year.[5]

In most cases, zinc coatings would not be used by themselves when applied to steel immersed in sea water but would form the first layer of a more elaborate protective system. This use of zinc coatings in conjunction with paint will be discussed in the next chapter ; the present discussion is concerned solely with the corrosion-resistance of unpainted zinc.

Conditions within a few hundred yards of the

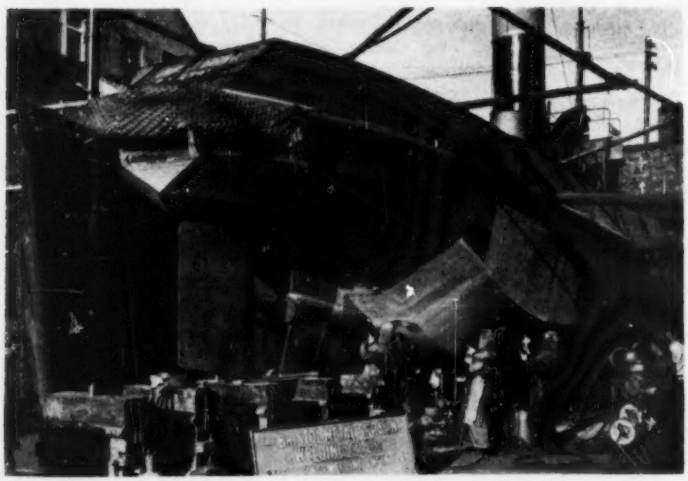

Fig. 23.—The fore part of this tug was painted after being sprayed with zinc.
(Courtesy of the Bristol Metal Spraying and Welding Co. Ltd.)

Table V

Location	Soil Conditions	After 5 years			H.D.G. pipe		Steel
		Excellent	Fair	Failed	Initial weight of zinc coating oz. per sq. ft.	Loss in weight* oz. per sq. ft.	Loss in weight oz. per sq. ft.
Benfleet	Alluvium or reclaimed salt marsh	4	1	1	1.9	1.1	4.7
Gotham	Keuper Marls (gypsum)	5	1	—	1.8	0.4	1.2
Pitsea	London Clay	6	—	—	1.8	0.4	3.7
Rothamstead	Clat with glacial flints	6	—	—	1.9	0.3	2.8
Corby	Made-up ground (ashes)	—	—	3	—	—	7.0

*of those specimens classed as excellent after 5-years exposure

surf line on beaches are intermediate between total immersion in sea water and normal exposure to a marine atmosphere. Such conditions have been studied in a series of tests carried out at Lighthouse Beach, near Lagos in Nigeria.[2] At the high-water mark, about 50 yards from the surf line on the tropical beach, conditions were extremely severe and both iron and zinc corroded more rapidly than if they had actually been immersed in the sea.

However, on moving inland, it was found that both the salt content of the atmosphere and the rates of corrosion of iron and zinc fell off very rapidly ; the values only three-quarters of a mile from the sea being similar to those obtained at inland sites.

SOIL CORROSION

Small-diameter galvanized pipe is frequently used to provide underground water services on farms, horticultural holdings etc. Although exposure tests have been carried out to examine the relative merits of a number of protective coatings in different soil conditions, it is extremely difficult to generalize from their results as it was found that the corrosivity of the soils varied widely, even within short distances.

In the B.I.S.R.A. tests described by Hudson and Acock[17], hot-dip galvanized coatings with a nominal weight of 2 oz. zinc per sq. ft. were examined after 5-years burial at 5 different sites :

At all sites, the hot-dip galvanized pipe resisted corrosion rather better than bare steel. The high rate of corrosion at Benfleet was attributed to the fact that the specimens were below the soil water level for about half their life as the tide rose and fell ; such conditions are found to be more corrosive than those at sites either permanently above or permanently below the soil water level.

In similar tests undertaken by the National Bureau of Standards in the United States [18], [19], the maximum depth of pitting was also measured. Except in the most corrosive soils, the maximum depth of pitting in steel specimens exposed for about 12½ years was more than 11 times that in zinc specimens even though the ratio of the rates of corrosion was only about half that figure. This resistance to pitting combined with the fact that rusting does not appear to start until nearly all the zinc and zinc-iron alloy layers have corroded away reduces the risk of premature failure in galvanized piping.

Denison and Romanoff.[19] found that the coatings on galvanized specimens remained virtually intact during 12½-years exposure in about half the 15 soils in which they were buried ; their corrosion resistance was most marked in alkaline soils. They concluded that, whereas a 2-oz. per sq. ft. zinc coating could be expected to provide 10-years protection in inorganic oxidizing soils, a 3-oz. per sq. ft. coating was necessary in moderately-reducing soils and that even heavier coatings were needed to give the same protection in highly-reducing soils.

In conclusion, it cannot be too strongly stressed that, while these results serve as a useful guide to the performance of zinc coatings in particular soils, local experience should always be sought to complement it.

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FLOW COATING for QUALITY FINISHING

By B. VAN DER BRUGGEN*

THE advantages of the flow coating method of applying paint are many and in view of the increasing interest being shown in this technique have been repeatedly dealt with in technical papers and the technical press, principally in comparison with other methods, such as dipping.

Both the growing fund of practical experience, now no longer limited to the other side of the Atlantic, and the continual development and improvement of the process and its equipment, have led to the flow coating method becoming equal to any other, manual or mechanical, methods of applying paint. In fact, the paint coatings obtained by this method, have, in many cases, qualities superior to those attained by the other methods. In particular industries, these qualitative advantages may be so apparent as to justify a preference for flow coating independently of the economic advantages to be attained.

In order to facilitate an evaluation of these possibilities this article will survey the principal qualitative and economic features of the flow coating process in a concise and comparative form, with special reference to the competing method of spray-coating. Consideration is given more particularly to conditions in European undertakings of moderate size, which have developed after several years of practical experience.

The following will be the principal points for discussion :

I. *General Advantages.*
Range and flexibility of application.

II. *Qualitative Advantages.*
Comparison with other methods.

III. *Economic Advantages.*
With special reference to spray-coating.

IV. *A Typical Installation (illustrated).*
The illustrations are of a newly-built flow-coating installation for the Berry Garage Door Division of the *Hoermann K.G.*, Steinhagen in Westphalia, who have kindly made the photographs available.

This concentration on the principal points in the comparative evaluation of the method, is essential because the finer points of any process, and their effects, will in the last resort be governed by the nature of the materials processed, and the articles to be treated. In any particular industry, the method used, the layout of the installation, the pre- and after-treatment of the work, and the final choice will be decisively influenced by these factors.

In addition, many techniques are nowadays being propagated under the name of " Flow Coating "—including spray-coating in tunnels, paint spreading and pouring machines intended for flat work only; which in their special applications may be very efficient, but which have little in common with flow-coating process proper, *i.e.* the process of " washing with paint " on an overhead conveyor. It is consequently necessary to state here that the remarks and data and the figures presented in this article refer only to flow coating in a tunnel-like duct or casing, with subsequent controlled paint run-off (draining).

I. General Advantages

Fig. 1 shows, on the side elevation of a flow-coater unit, the principal features in a concise form. Variations in size and layout of the installation, dictated by particular requirements, do not affect the fundamentals of the operating method, which, as will be already known, are akin to the technique of washing metals by pressure jet. In its end effect, the flow-coating method differs from this technique, however, since the process liquid is not expected to run off or drain completely, but to remain on the surfaces of the work as a paint coating or film.

This requirement entirely governs the method of treatment and the layout of the equipment; a careful choice of pigment medium and its composition is important for obtaining optimum paint flow with least wastage of solvents or thinners. As the author's own experience has shown, the loss of solvents and thinners by evaporation, which is a frequent criterion, can be kept very low, provided the selected flash points and, arising therefrom, the structural problems involved in fulfilling safety regulations, which influence the installation layout (paint circulating system, ventilation, etc.), do not impose undue restrictions.

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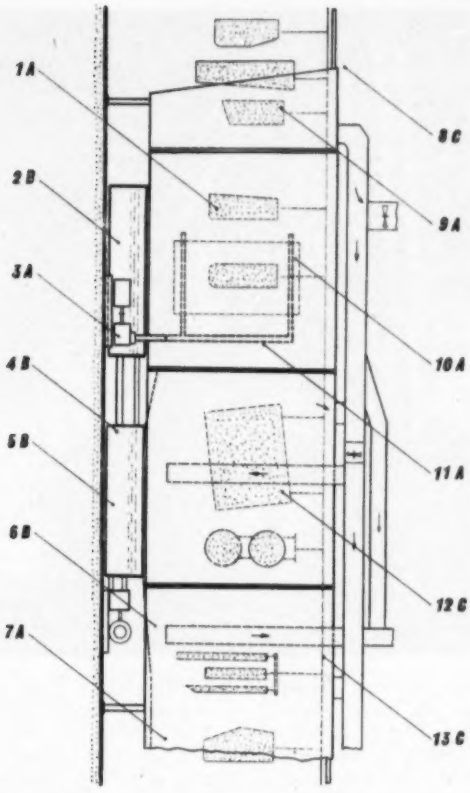


Fig. 1.—Elevation of the Paint Application Section of a Flow Coater indicating the salient operating and treatment features (diagrammatic).

(left hand)

1A.—Paint protection overall including assembly joints, paint being forced into all cracks, recesses, pores etc.

2B.—Limited volume of paint in use (small-capacity baths), smaller fire risk, smaller investment capital, no ageing losses as in deep dipping baths.

3A.—Paint composition (pigment dispersion) remains constant; clean coatings obtained by continuous paint circulation and filtering.

4B.—Installation mobile since no floor level baths, no excavation, installation possible in upper storeys.

5B.—Less paint settling during work pauses, owing to shape and shallowness of baths, also, easier temperature control.

6B.—Better respiratory hygiene and less risk of fire and pollution of surroundings, by using overall casings and control of solvent concentration.

7A.—Controllable and dust-free feeding and draining of the paint in the evaporation zone, the so-called drain tunnel.

(right hand)

8C.—More efficient utilisation of the conveyor per unit length per hour, by closer spacing of the work pieces than is possible with perpendicularly-curving or dipping conveyors, or in manual spraying cubicles.

9A.—More reliable paint adhesion (keying), light surface contaminations are floated off by the dynamic friction between the paint flow and the work surface.

10A.—Non-porous and homogeneous paint film penetrating into all depressions, free from bubbles, by jet application of the paint without atomising (spraying).

11A.—Viscosity control in the paint-application zone, made more quickly effective by more thorough paint mixing (in the pumps and filters.)

12C.—The work-piece adjustment (for paint draining) is more easily adjustable to the rate of degreasing and washing, than in spray-coating.

13C.—Higher unit output per hour, since the conveyor speed is less dependent on fixed process times (e.g., dipping, spraying, etc.)

A.—Painting technique.
B.—General Advantages.
C. Conveyor efficiency.

This point is of particular importance, as the application of paint by flow coating in which low solvent loss is solely or principally obtained by controlling the paint flow (*e.g.* by washing the paint more gently over the surface of the work), usually causes some of the substantial qualitative advantages of the process to be lost. This applies more particularly in ground-coating, where the desirable " washing-in " of the paint into the surfaces is, or can be, the qualitatively positive feature of the process.

The extraordinarily wide scope of the process is illustrated by the possibility, often becoming a necessity, of using a liberal excess of paint. This is in direct contradiction to the practice in automatic paint-spraying, the particular arrangement and action whereof require to be in great measure adapted to suit the character of the work-pieces to be treated, if insufficient paint coverage, or excessive paint drainage, are to be avoided. A correctly built flow-coating installation thus allows of series of work-pieces of varying shapes and sizes to be painted in a single run through the installation, without any adjustment of the paint-applying mechanism. This most desirable attribute does not even exist in the most flexible of all paint-applying systems, *i.e.* painting by hand, since even there different hand motions are necessary, depending on the shape of the work.

While the method of treatment used is thus the best adapted to make fullest use of the equipment, assuming that its design and construction are satisfactory, this is even more the case in regard to installation layout. The possibility inherent in the flow-coating system, whereby the work conveyor can be set horizontally or nearly so, affords the following structurally important advantages:

(a) Reduced space requirement, *i.e.* shorter conveyor paths compared with installations in which the conveyor has to be given a considerable rise or fall—as in the case of dipping baths, or the hand-spraying of tall work-pieces.

(b) The conveyor paths and the flow-coating equipment can be arranged in the upper storeys of buildings, since the paint baths do not require to be at floor level, as is often necessary in the case of dipping baths etc.

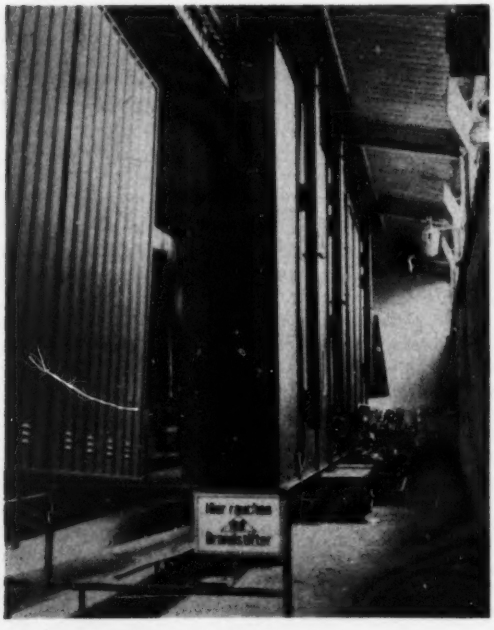
(c) Independent speed control of the conveyor, giving higher conveyor performance than in dipping and spraying installations (withdrawal speeds, manual spraying times).

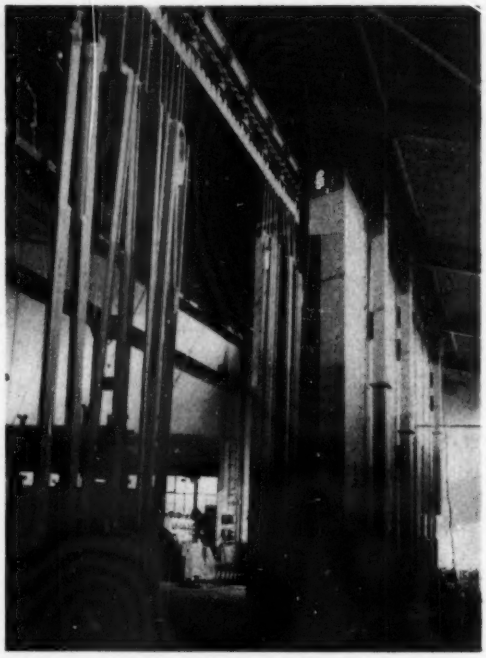
(d) The conveyor utilization is 30 to 40 per cent higher than possible in manual spraying, and often better than in dipping methods (the intervals on the conveyor for spray-gun adjustment and work-piece feed on rising gradients are eliminated).

(e) Smaller space requirement than in even modern spray-painting units (working depth of spraying cubicle, washing-out space, working space for operator, eliminated). If a flow coater can be arranged to do the work of two spray units, a perceptible gain in space is obtained, at least in width.

(f) Considerably less risk of fire or spontaneous ignition compared with the use of spraying cubicles or dipping tanks holding large quantities of paint. Compared with the waste paint accumulations in spraying cubicles (paint mist deposited on walls and floors), the paint residues in the flow coater are considerably less.

As Fig. 1 shows, the enumeration of the advantages of flow coating can be still further extended. They are considerable even allowing for the fact that other painting methods also have their specific





and inherent indisputable advantages. This is not the place, however, to discuss the best-known and often described advantageous features of other painting systems: rather, it is proposed to demonstrate that a number of features make flow coating suitable even in cases where other methods of painting have hitherto been used with complete success.

The range of usefulness of the flow-coating method can be outlined as follows :

(a) Sheet-steel parts of ordinary shapes, hitherto spray-painted; also, work-pieces in which corners, recesses, etc. cannot be properly reached by spraying.

(b) Castings and machinery parts hitherto sprayed or dipped, the rough surfaces of which make particularly good paint adhesion desirable (multiple paint coats).

(c) Welded and riveted parts in which paint requires to be worked into the joints—provided the work-pieces are of convenient size.

(d) Sheet-metal and cast work of suitable shape and size requiring increased protection by even and homogeneous paint coatings.

(e) Work-pieces of suitable shape in which the application of a ground coat requires an excessive

Fig. 2—(left): Part view of shop side bay with flow-coating installation.

Fig. 3—(above): Front view of the flow coater.

expenditure of time and material, which is usually the case when spray-painting is used (excluding painting in several colours, frequent change of the paint used, or work-pieces with numerous holes, screw threads and other machined parts).

The application of the flow-coating method is less restricted by length or height of the work to be treated, than by the width and overall bulk (width clearances in the installation).

II. Qualitative Advantages

The paint films applied by the flow-coating method are more uniform than those obtainable by manual spraying; in the latter case, even with highly-skilled operators and even spraying, there is always the risk of obtaining alternating thicker and thinner strips or overlaps, even if invisible to the eye.

This is particularly noticeable on large, flat surfaces which cannot be sprayed manually at an even rate all over, and without resetting the spray gun, thus spraying wet on wet. Even if the paint spray is sufficiently regular, differences in the coating obtained are clearly apparent, and lightly brushing over the finished surface with the finger tips will show the usually much smoother surface obtained by flow coating.

This is particularly true in regard to the ground coat, the composition of which often causes, in spray-coating, a partially "gritty" or granular finish; this makes some rubbing down of the ground coat necessary. A slightly rough, gritty finish as a keying surface for the following coat of paint can, however, also be obtained in some degree by flow coating while the paint film remains homogeneous.

In the flow-coating process, as also to some extent in dip coating, the thickness of the applied film can be varied within fairly wide limits and made thicker or thinner in places as may be required. Contrary to the spray-coating process, the viscosity of the paint, which in that case is adjusted by adding thinners or by heating the paint, does not play such an important part in flow coating. This is explained by the nature and diameters of the paint-applying elements.

The author's own carefully conducted tests have confirmed that it is possible to apply stoving enamels in the flow coater at a viscosity which would be quite impracticable with spraying equipment. Work-pieces of suitable shape, so treated, were not only completely protected by a non-porous film of adequate thickness, but were given an appearance resembling that of the best fired enamel; such an appearance is only approximately attainable otherwise with hot-sprayed, high-grade enamel paints. The pleasing appearance of enamel paints applied by flow coating, is often and rightly considered in the United States, to be a strong selling point—without neglecting the simultaneous protective effect. This full-bodied paint coating is particularly indicated where special requirements obtain: *e.g.* high wear resistance, physical or chemical action, etc.; or, where a foundation not absolutely smooth has to be well covered.

It is nowadays becoming increasingly clear that such heavy paint coatings can also be obtained with paints of ordinary viscosity.

Additional reinforcement of the paint film is almost always possible at the bottom, or downward-hanging edges of the work pieces. First, in view of the paint run-off or draining, the paint coating is always thicker there; this effect can be further enhanced by locally controlling the drying process, within the range of the run-off edge, by artificial means.

This affords the possibility of giving the work a locally-reinforced paint protection, in the lower part or along the bottom edges. In many cases, such as steel furniture, washing machines, slot machines, garage and other doors or gates etc., these bottom parts are the most heavily exposed to wear, *e.g.* by rubbing against floors, kicks, when cleaning floors, by moisture, running liquids, dust, impact, etc.

The variation in paint-film thickness between top and bottom, normally occuring in flow coatings, and, in fact, not readily avoidable, which not three years ago was often complained of as a disadvantage is today in many instances a valued quality characteristic. It is now nearly always acknowledged that a film of even double thickness on the lower

Fig. 4—Ventilator section of the flow coater with inspection window

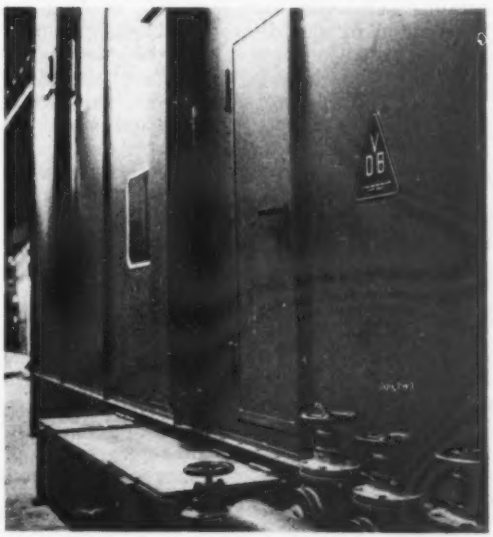


Fig. 5—Reversing curve of the closed-circuit chain conveyor.

part of work-pieces of various forms may be highly desirable. This variation in film thickness, from the top downwards, can be obtained without steps or ridges in the case with flow coating, and is thus imperceptible to the eye. This refers not only to ground coats, but also, in part, to top coats on vertical surfaces.

This is not meant to imply that in paint application by flow coating the difference in film thickness between top and bottom is regularly 100 per cent, and inevitable; there are possibilities of remaining at the minimum condition, in which the paint run-off distance, the so-called " drain tunnel," its length and ventilation thereof, the paint composition and its viscosity, as well as the placing of the work, are of decisive importance. On pickled steel work of ordinary sizes and shapes, the thickness of the paint film differs no more than it does on spray-painted surfaces, particularly if measurements are also made in the places in which the paint spray has passed over once, twice, or even thrice. This comparison excludes flats which remain quite or nearly horizontal, even though the work-piece may be suspended at an angle, *i.e.*, those from which the paint cannot run off readily. In such cases, a considerably thicker paint film will become deposited in these places, which may easily be double the thickness of the film on vertical surfaces. If the paint is then stoved, the difference is hardly perceptible if such small defects (paint residues), are brushed smooth before the work goes into the stove. That is always possible, and, indeed, advisable in the case of ground coats, where a specially good finish is required. The manual labour involved is small, and can usually be supplied by the operator already responsible for the working of the flow coater, or attending to the chain conveyor.

Unattainable by any other means is the mechanical action of " washing on and washing in" the paint which is obtained in the flow-coating process. This characteristic deserves special mention, since it ensures that the paint really penetrates into all pores, cracks and joints of the work.

No such penetration of the paint into the surface of the work is obtained by any other form of application, whether dipping into static baths of paint, or by spraying it in a finely-divided state. The impact of the jets of paint washes away any remaining dust and forces out any air remaining in the pores and cracks; whereas, when the paint is sprayed, the air held in the cracks, joints etc., offers resistance and thus prevents the paint from penetrating. The mechanical action of applying the paint by the flow-coating process enables particularly good adhesion even in such places.

Consequently, the technique of applying the paint in a tunnel or duct, is an essential feature in obtaining high product quality by flooding the paint on the work. It is apparent that mere pouring or sprinkling the paint cannot produce such good adhesion—in fact such a method of application would hardly be any better than the mechanical effect obtained by spraying with a paint gun. In this case also, it is a matter of not sacrificing marked quality improvement to any merely " possible " saving of thinners and solvents. In the same context it should be noted that the probably much simpler technique of spray-coating in a flow coater involves unnecessarily high solvent consumption, and is furthermore far less efficient in " washing-in " the paint.

The fewer sharp edges there are in a work-piece the better it will be suited for flow coating, since the paint usually drains more quickly from such edges than from rounded edges. In the least favourable conditions, such edges have to be finished afterwards by spraying, if an enamel is to follow, by a " wet-on-wet " spray. Some degree of after-spraying will usually be more economical than treating the whole work at a slower application rate, for the same purpose. In modern work and with modern methods of sheet-metal working, therefore, such sharp edges are increasingly being avoided.

The principal qualitative advantages of the flow-coating method may thus be summarized as follows :

1. Better keying or adhesion of the film owing to the " washing-in " action.
2. Non-porous, smooth and even coatings;
3. Coatings have more resistance to wear owing to their greater thickness.

4. Better protection by the paint of the bottom parts of the work usually exposed to heavier wear.
5. Less risk of defects due to bad cleaning, since surface contamination, *e.g.* by dust and dirt, is to some extent washed away during application of the paint, or at least evenly spread over the surface.

III. The Economic Advantages Compared with Spray Coating

Table I gives a comparative cost analysis of flow coating and spray coating, showing the savings attainable by changing from the latter to the former.

With regard to this Table,* which clearly shows the much higher economy of the flow-coating process, better than any lengthy description could do, it is only necessary to remark that it is based on the operation of two spraying cubicles of modern construction with the necessary ventilating equipment etc., and is assumed for a fixed volume of paint consumption annually.

If, for instance, the available spraying equipment is not of modern design or no heating of the intake air is provided, or in the case that a single spraying unit can be replaced by a suitable, small flow coater, then the attainable saving by the adoption of flow coating will of course be less, perhaps 30 to 40 per cent. The exact result can in every case be evaluated only after check and analysis of all the material factors.

Similarly, the numerical values stated for the (quantitative) paint-solvent consumption, apply only for the particular case. The percentage loss of solvent may be lower than that assumed here, but if the layout of the equipment is inconvenient or the paint formula used unsuitable for the process, solvent consumption may many times exceed the figure given in the table. However, also in these cases, the high degree of mechanization attainable by the adoption of the flow-coating method will act to balance such disadvantageous factors—which does not mean that an excessive solvent consumption is an inevitable factor. That is not so, and should not be tolerated from the outset. The decisive factor in the selection and construction of a flow-coating system should in the majority of cases be the standard of quality required.

The economy of the process is also considerably influenced by the surroundings. The efficiency, and therefore the economy, of any flow coating installation, as of all tunnel systems generally, is equally influenced by the care and attention paid to preliminary and subsequent treatment of the work, *e.g.*, surface cleansing and paint drying, which should be matched to the intended rhythm of the conveyor chain.

Even with flow coating, a qualitatively high grade paint covering can only be obtained if the layout and construction of the equipment provide the necessary flexibility in operation, and the rate of paint feed, circulation of the paint, heating and cooling arrangements, viscosity control etc. are all correctly matched to one another. Special mention should be made of the prescribed safety measures and safety regulations, which should all be carefully observed.

(*Continued in page* 460)

Table I

Cost Analysis of Flow-Coating and Spray-Coating Systems.
A comparative analysis of a paint-spraying and an equivalent flow-coating installation (closed-circuit conveyor).
Plant running time : 45-hour week, 2160 hours p.a.
Treatment : Single ground-coating with paint or enamel.
Nature of Work : Various sheet-steel components for electrical equipment, of average size.

Spray Painting		Flow Coating	
Working Time (labour cost)		*Working Time* (labour cost)	
Paint application manual	—2 sprayers	Paint application automatic conveyor operation, handling, servicing, maintenance	—2 labourers
= 4 men = 720 hours per month = 8640 hours p.a. at Frs. 3.- per hour	= Frs. 25,920	= 360 hours per month = 4320 hours per annum at Frs. 3.- per hour	= Frs. 12,960
Power Required (2 spray cubicles and equipment) : Paint mist exhauster, washing-out, space ventilation, air-heating, compressed air etc. :		*Power Required* (flow coating tunnel) : Paint feed, exhausters and fans, paint heating and cooling, filters, etc.	
Motor Power : 25 hp/hour	= 54,000 h.p.	Motor Power : 15 h.p./hr.	= 32,400 h.p. p.a
Heating : 150 kW-hour	= 324,000 kW	Heating 25 kW-hr.	= 54,000 kW p.a
Total	378,000 kW-h.p. p.a.	Total :	86,400 kW-h.p. p.a.
at Frs. 0.05 kW h.p./hr.	= Frs. 18,900	at Fr. 0.05 kW--h.p./hr.	= Frs. 4,320
Paint Consumption (for manual spraying — 45-55 % utilization). Assuming 50 % utilization and a total paint volume equivalent to Frs. 40,000 cost per annum :		*Paint Consumption* (for flow-coating — 70-80 % utilization) Assuming 75 % utilization and a total paint volume equivalent to Frs. 40,000 cost per annum :	
Spraying Loss	Frs. 16,000 p.a.	Paint Losses	Frs. 2,000 p.a.
Thinning Losses	,, 4,000 ,,	Thinning Losses	,, 8,000 ,,
Total	Frs. 20,000	Total	Frs. 10,000
Grand Total Frs. 64,820 (spray coating)		Grand Total Frs. 27,280 (flow coating)	
Assumed : 1 kW = 1 h.p. For Diesel or steam drive the power costs, averaging 75 kW-hr. per cubicle, will be less. A large spraying cubicle with continuous work feed or a large spray unit can be practically equated to 2 average spraying units.		Two men only needed for conveyor operation if bulky or heavy articles handled. Servicing and inspection in work pauses. Flow coating instead of spray coating requires the equipment to be run only 5-6 hours per day instead of the full 8 hours for the sprayer. Adequate paint-drying facilities (stoves or drying chambers), are assumed.	

Paint-drying power costs are the same in both cases and have therefore not been included above.

*The figures given in this table are average values taken from a cost analysis made for an undertaking manufacturing electrical components. They do not refer to the example of an existing installation given at the end of this paper ; for obvious reasons, the costing data for this considerably larger plant are not yet available.

Progress in Polishing

(*Continued from page* 444)

finish, it was said, That was not altogether true, because the printing trade and certain other trades specified a particular type of finish. For example, the printing trade, invariable specified that it must get down to 1-2 micro-in. in finish. If there were a demand for the use of liquid polishing composition to produce a good standard of surface finish, the demand must come from the manufacturers. In certain conditions the industry could produce a finish to a given micro-inch depth.

MR. SCOUSE dealing with the question of micro-inch finishes and the type of finish required, pointed out that it was still necessary to inspect after a polishing operation, whether it was on an automatic or semi-automatic machine. Unfortunately, visual inspection was the only method which could be applied at present.

MR. E. G. PARDY said that during controlled works trials which the Cutlery Research Council had conducted, it had been possible to achieve a surface of 50-60 centre line average down to a surface finish of 4-6 centre line average on an automatic machine, using a time cycle of four minutes.

Wear of Gun Jets

MR. ANDERSON, referring to the wear of gun jets, said that one of the largest users of automatic equipment of this kind, took the guns out of service every 500 hours and completely overhauled them. They expected 1,000 hours of the pumps and then stripped them and installed new gland packings. After 500 hours they put new nipples in the guns, as well as packings. They also replaced weak springs.

MR. J. SPRAGUE said that when polishing softer and more reactive metals like aluminium on copper the polishing medium could be driven into the surface. This was shown in the reflectivity of aluminium as finished by chemical or mechanical means. It could affect the finish of a chromium-plated surface when copper was one of the under-coats and had been put on by a bright plating process or a process involving mechanical polishing.

It seemed to him that the method of liquid polishing had an advantage in that it was a more lubricated process and might therefore involve less abuse of the basis metal and less reaction with it.

MR. SCOUSE said he had intended to deal with that point when he had indicated that the fat or fatty acid which they emulsified has a greater bearing on the degree of polish than had the type of abrasive used. He felt that this had a much greater bearing than was commonly realized. The authors agreed that the fat part of the polish had this effect.

Flow Coating for Quality Finishing

(*Continued from page* 459)

IV. A Typical Installation

As an example of an actual installation the flow coating equipment for painting the sheet-steel components, sections and panels of Berry garage doors, built for the Hoermann K.G. of Steinhagen in Westphalia, can be mentioned.

For this installation, in addition to the usual requirements of a thoroughly rationalized production flow, the more effective surface protection obtainable by the flow-coating method was the deciding factor in the choice of system, since garage doors not only experience wear and tear during transportation and storage but are also exposed, on the site, during erection, and when in service, to the weather.

As actual experience has shown, the method and the equipment have proved capable, not only of furnishing absolutely smooth and even paint coatings, but also the desired " washing-in " of the paint into the assembly joints and on to the edges of the various sections. The required heavier paint protection on the lower parts of the doors was also evenly and automatically applied, without the need for separate paint sprays for this purpose, and despite the considerable height of the work-pieces, which was unusual for flow coating. Furthermore, simply flooding with paint from above would not have ensured covering such parts as were situated at the top of the work piece but accessible only from underneath.

The paint coatings were almost completely free from dust, although the work-pieces have to travel in the open on the way to the flow coater. This freedom from dust was the result of the " surface-washing " effect simultaneously obtained in this method, the paint being filtered before being re-circulated, further helped by adjusting the paint flow rate in the installation (distance of flow, piping diameter) to allow even the lighter dust particles to settle out before the paint returns to the pump. In spite of pre-treatment, the surface dirt progressively washed off during prolonged treatment periods accumulates to a considerable extent, a problem requiring special attention when designing the paint-circulating system (pigment precipitation, paint heating and cooling) and for which pressure filters alone are inadequate.

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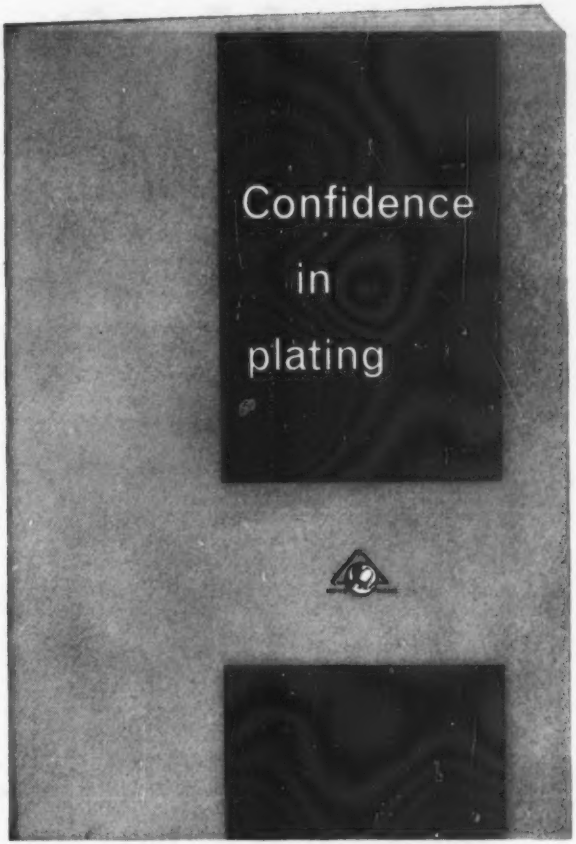

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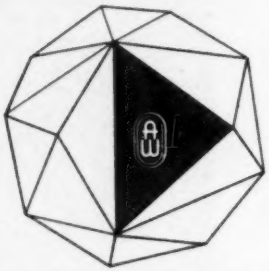

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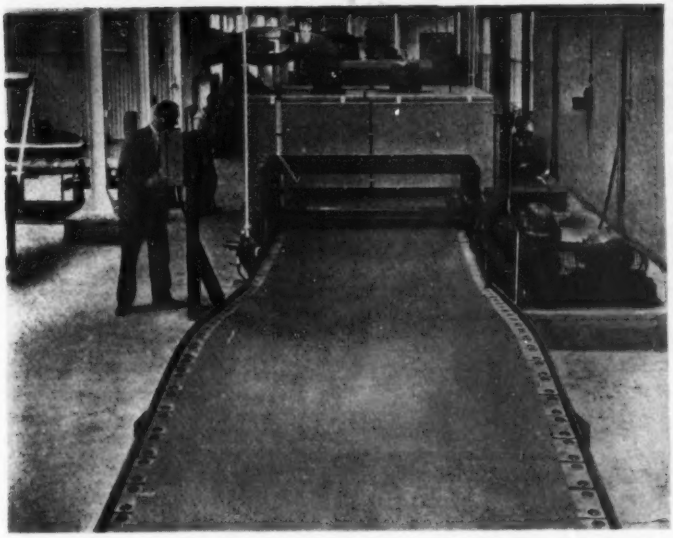
FINISHING

NEWS REVIEW

"Artbrite" being made at Stour Vale

R.T.B.'s commence production of plastic coated steel sheet



Production started recently at Richard Thomas and Baldwin's Stour vale works of "Artbrite" plastic coated mild steel sheet. The company say that the material is cheaper than many plastic and composition materials and has greater strength.

"Artbrite" is being made under licence from BISRA, where the product was developed under the name of "Plasteel," according to Ingot News, the monthly newspaper of R.T.B. Further development was made on a pilot production line at Whitchurch.

One of the problems surmounted in the process has been the bonding of the plastic coating to "Speltafast" galvanized sheet. An advantage of this, of course, is the improved corrosion resistance of the sheet metal, and even when the sheets of "Artbrite" are cut by the manufacturer there is a substantial carry over of zinc on the steel sheet edges that will resist corrosion, R.T.B.'s claim. For extra deep drawing where Speltafast might not be the ideal material, mild cold reduced sheet protected by a lacquer treatment is available.

R.T.B.'s plant at Ebbw Vale supplies the coils for the "Artbrite" line. After initial cleaning, degreasing and the chromate-phosphate treatment, an adhesive used to bond the plastic to the steel is applied and subjected to a stoving process.

The plastic sheet and metal are then brought together, and the bonded product is quenched and cut.

Width and gauge of the material, all maximum, are as follows :—16 to 20 gauge, 48 in. ; 22 gauge, 43 in. ; 24 gauge, 39 in., and 26 gauge, 36 in.

One of the first consignments of "Artbrite", plastic side uppermost, seen leaving the finishing end of the equipment installed at Stour Vale.

Production Exhibition at Olympia

THE next Production Exhibition, the fourth in the series, will be held in the National Hall, Olympia, from April 25—30 next year. It should provide an up-to-date survey of aids, techniques and processes for greater efficiency. A series of conferences to be organised by the British Productivity Council with the title "Productivity, Men and Methods" will be held during the exhibition. Names of speakers and further details will be announced later.

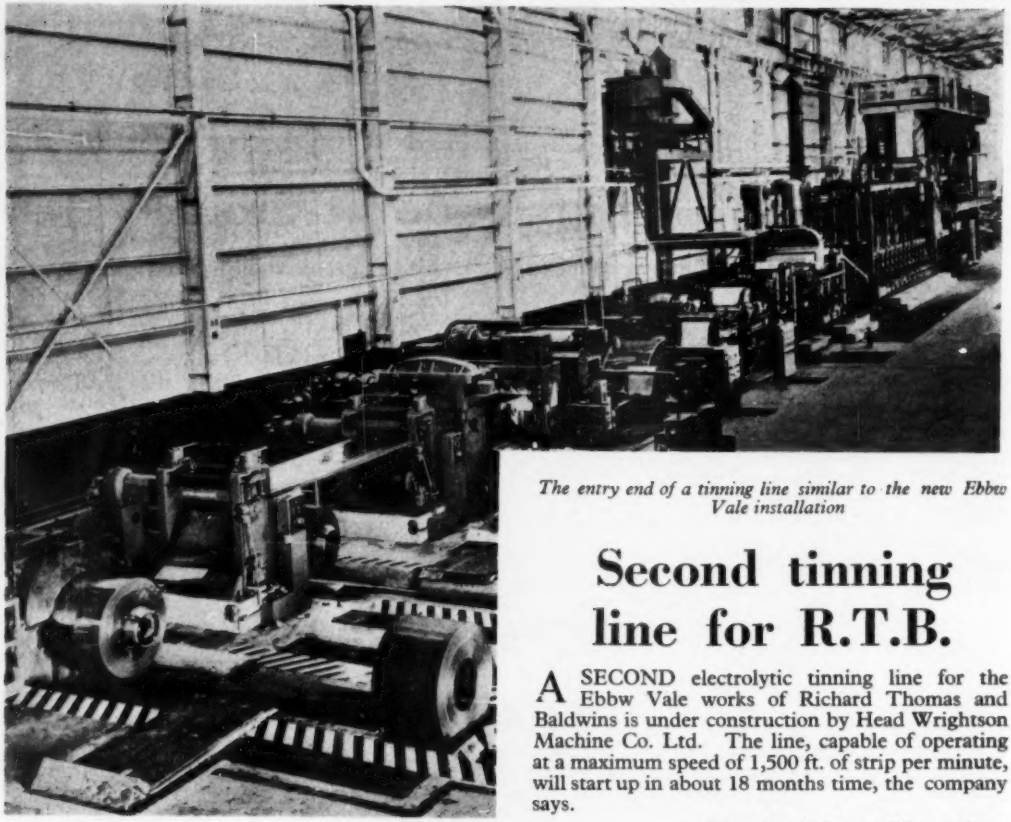
More than ever before British Industry can be justly proud of its achievements during the past few years. It was not so long ago that new developments were closely guarded, but today many of the best practices and methods used by leading firms are communicated to the whole of the industry.

Phosbrite Deliveries by Road Tanker

BULK deliveries of chemical polishing solutions are now being made to Haynes, Ford and Elliott Ltd., the Birmingham metal finishing firm, by Albright and Wilson (Mfg) Ltd.

The first delivery, made by a 6-ton tanker last September, cut costs and made handling very much easier. A storage tank to take a thousand gallons of Phosbrite 159 had previously been installed by H.F. and E.

The company operate a 600 gal. Phosbrite tank with a throughput of close on 5,000 sq. ft. surface area per day, of which half is SP aluminium, or alloy of 99.8 per cent. purity or better. A wide variety of items from automobile bright work to domestic appliance trims and curtain rail are chemically polished there.



The entry end of a tinning line similar to the new Ebbw Vale installation

Second tinning line for R.T.B.

A SECOND electrolytic tinning line for the Ebbw Vale works of Richard Thomas and Baldwins is under construction by Head Wrightson Machine Co. Ltd. The line, capable of operating at a maximum speed of 1,500 ft. of strip per minute, will start up in about 18 months time, the company says.

Then it will be possible to give a range of coatings up to 16 oz. per basis box of tinplate and to supply plates with a different weight of coatings on the two sides of the plate.

Doubles range

Commissioned in 1947, the line at present in use at Ebbw Vale gives a coating of 8 oz. per basis box at a speed of 600 ft. per min. Ancillary equipment for use with the new line will include strip preparation plant, tinplate cut-up lines, and inspecting and sorting units.

The line is being designed in collaboration with the Aetna Standard Division of the Blaw Knox Co. of America, with whom the Head Wrightson Machine Co. Ltd., have been associated for several years.

NO PROSPECTS FOR CHEAPER ZINC

ACCORDING to recent reports in both the Financial Times and the Daily Telegraph, users of zinc can expect to pay higher prices for the material after a series of market rises that have taken place recently.

The F.T. points out that even though these higher market prices might have been caused by a local acute shortage in London, zinc for delivery in three months' time also rose in price during October, although at a slower rate. Recent prices have reached their highest since May, 1957, a striking recovery over prices standing in April of this year, when the United Nations Lead and Zinc Conference took place.

Since then, restrictions agreed to by members of the Conference have turned a world surplus of approximately 159,000 tons a year into one of only 16,000 tons. The F.T. says that it is possible that with the industrial recovery in both the the U.S. and Europe, there may now be no surplus of zinc production over consumption, although a complicating factor is that the steel strike in the U.S. had probably also reduced consumption of zinc by one of its biggest users, the automobile industry.

COPPER FROM NCHANGA MINE WORKINGS SOON?

THE Anglo-American Group is carrying out research to find a suitable and economic process for recovering copper from the banded sandstone which overlies the main Nchanga orebody in Rhodesia.

Reporting this, Barclays Bank D.C.O. in a message from Northern Rhodesia, says that results are encouraging and that if a successful method of extraction can be evolved large tonnages of low-grade ore could be drawn from current and old underground workings as well as from the Nchanga open-pit without any further major expenditure on development.

SEBEL'S SCOOT-A-BIKE IS IN ZINTEC

PRODUCTION of a toy "motor scooter" for the very young was bound to follow the rapid rise in scooter transport popularity. Seen in the picture above is the "Scoot-a-Bike" made by Sebel Products Ltd., Erith, Kent, makers of the well-known Mobo range of toys.

It is a realistic copy of a motor-scooter with a contoured pressed steel body and leg shields. Designed for children between three and seven years of age, it is pedal driven with heavy moulded rubber tyres and rubber wheeled outriders for safe balance. Leg reach is between 15½ and 20½ in.

The material used is Zintec, the sheet steel with a coating of electrically-deposited zinc produced by John Summers and Sons Ltd., Shotton, Chester. Sebel's use Zintec for many of their large toys—including their famous Mobo pony—most of which are designed for outdoor as well as indoor use. Toys left in the garden will not easily rust.

Sebel's also use Zintec for their metal chairs, many of which are exported to countries where the climate can cause quick deterioration of some materials.

A further advantage recently found by the company is the heat resistance of Zintec, which is now being used for retaining rings and flame shields in the Jetex engines used in model aircraft. Previously a special heat resisting alloy had been used, necessitating additional expense, but Zintec has proved perfectly satisfactory.

HEATING VITREOUS ENAMEL FUSING FURNACES

THE development of the Incandescent Heat Co.'s "Jetube" radiant heating element for use in vitreous enamel fusing furnaces was referred to in a paper to the Scottish section of the Institute of Vitreous Enamellers in February 1958. Its brief mention aroused considerable interest, and since that time two prototype furnaces using specially designed Jetubes have been built and tested by the development division of the Incandescent Heat Co. Ltd.

Now the first batch furnace using this system has been built for an important vitreous enamelling works, and will be in service in a few weeks. A continuous split crown furnace, also heated by Jetubes, has just been commissioned at the works of Smart and Brown Ltd., Spennymoor, Co. Durham.

The Jetube radiant element (which can be gas or oil-fired) gives wide flexibility of operation, and allows the use of a highly insulated furnace structure with low thermal storage. Consequently fuel consumption is said to be low and output increased. The heating elements are already being widely used for metal treatment processes.

Cutting cost of tools at Vickers-Armstrongs

Reclamation of files by electro-etching

REPORTED in a recent issue of "Target," the monthly bulletin of productivity issued by the Central Office of Information, Hercules Road, London, S.E.1. is a method of reclaiming files by electro-etching.

Developed by Vickers-Armstrongs (Aircraft) Ltd. at the South Marston works, the process has cut the issue of new files from 850 to 300 a week.

Pretreatment consists of immersing the files in a solution of 10 - 15 per cent. caustic soda at 80°C. Immersion follows in a lead-lined electrolytic bath containing stainless steel cathode plates and an anode bar to which the files are attached. Water-cooled cathode plates proved desirable, as the temperature of the electrolyte should never be allowed to rise above 45°C. Sulphuric acid gave the best results at 50 deg. Beaume density and having a working concentration of 50 - 60 per cent. of sulphuric acid by volume. After immersion in the acid, the files are washed in a hot water bath.

Dreadnoughts' best

The coarser cut files give the best results. Broken teeth obviously cannot be built up. The treated files have successfully been used on Jabroc, Perspex, glass-cloth laminate and similar materials. Reclamation costs are about 45 per cent. that of replacement and some files have been treated up to seven times.

No patents are being claimed for the process.

CONSOLIDATED'S NEW BRISTOL OFFICE

A NEW district office in Bristol to serve industry in the West of England has been opened by the Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6.

The new office, opening on December 1, will be under the management of Mr. J. D. Glover, and is at 1, Bedminster Down Road, Bristol 3, Telephone: Bristol 63736. Its operations will cover the counties of Somerset, Devon, Cornwall and part of Gloucester.

The branch office at Bridgend, Glam., formerly serving this area will continue to operate as the south western district for the South Wales counties, Hereford and part of Gloucester.

Technical & Industrial Appointments

Mr. Michael J. S. Clapham has been appointed chairman of **I.C.I. Metals Division** in succession to Dr. Maurice Cook, C.B.E., who retires from the company's service on December 31. Mr. Clapham has been joint managing director of the division since October, 1952.

Mr. Clapham is a director of Pyrotenax Ltd., Yorkshire Imperial Metals Ltd. and Imperial Aluminium Co. Ltd. He is chairman of the Non-Ferrous Wrought Metals Export Group and a vice-president of the British Non-Ferrous Metals Federation.

* * *

Mr. F. C. Braby, M.C., D.L., M.I.Mech.E. (chairman and managing director of Fredk. Braby and Co. Ltd.) has been elected chairman of the council of **The British Non-Ferrous Metals Research Association** to succeed Dr. Maurice Cook, C.B.E. who retires from office on December 31.

Mr. Braby, a graduate in engineering of Manchester University, is a prominent figure in the engineering and metal manufacturing industries. A past president of the Engineering and Allied Employers National Federation and of the London and District Engineering and Allied Employers Association, Mr. Braby has also contributed much to the managerial efficiency and technical aavancement of the galvanizing industry through his service as chairman of the Hot Dip Galvanizers and the Galvanized Tank Manufacturers Associations.

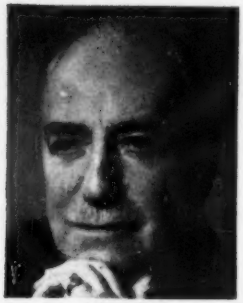
* * *

Mr. N. R. Crump, president of the Canadian Pacific Railway Co., has been elected a director of **The International Nickel Co. of Canada Ltd.**

Besides being a director of Canadian Pacific, Mr. Crump's directorships include Bank of Montreal, The Consolidated Mining and Smelting Co. of Canada Ltd. and Mutual Life Assurance Co. of Canada. He is a governor of McGill University and Royal Victoria Hospital, Montreal, and a trustee, Corporation of Bishop's University, Sherbrooke, Quebec.

C. F. Tracey

M. J. S. Clapham



F. C. Braby

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The **Pressed Steel Co. Ltd.**, announces that Mr. Cecil F. Tracey has joined its organisation as a divisional director of the Prestcold Division with the title of production director of the new Swansea plant.

* * *

Lt.-Com. Douglas F. Battison, R.N. (Retd.), has recently been appointed sales manager of **Electropol Processing Ltd.**, Trading Estate, Farnham, Surrey.

Mr. Battison took the Associate of Metallurgy Course at the University of Sheffield prior to entry into the Royal Navy in 1941, where he served as a regular officer until 1959. He has lectured and has had much experience in overseas contacts.

In 1936, he began his association with stainless steels on joining Brown Bayley's Steel Works, Ltd., Sheffield.

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Mr. P. J. Scratchley has resigned from **Union Carbide Ltd.** 103 Mount Street, London, W.1. Mr. R. Wilson, the divisional managing director, has temporarily assumed responsibilities of sales manager for the alloys division.

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At the recent annual general meeting of **Detel Products Ltd.**, Stonefield Way, South Ruislip. Sir Oswald A. Scott, K.C.M.G., D.S.O., was elected chairman of directors, in place of Admiral H. P. Boxer, who did not stand for re-election.

* * *

A department handling precision instruments and aids to navigation has been set up by **Wallace and Tiernan Ltd.**, Power Road, London, W.4. It will be responsible for the manufacture and marketing of pressure sensitive instruments and navigation aids.

Mr. J. T. Furness, who has been with the company for ten years, has been appointed manager of the new department. Mr. G. L. Walton, previously manager in north-east England, will take over responsibilities from Mr. Furness as Manager in east Lancashire and the surrounding district.

Highly accurate instruments in this category have been produced for many years by W. and T.'s associate company in the U.S.A., and this new development will meet the increasing demand for similar equipment of British manufacture.

The pressure sensitive instruments are available for various applications and include : pressure indicators ; gauges ; vacuum and differential pressure indicators and pressure control instruments.

* * *

The development branch of **The Mond Nickel Co. Ltd.'s** development and research department has recently been reorganised into four divisions under the general managership of Mr. F. Dickinson, a director of the company.

The divisions are as follows : ferrous division manager, Mr. W. W. Braidwood ; non-ferrous division manager, Mr. J. Hinde ; applicational engineering manager, Dr. A. B. Everest ; general division (including plating, chemical products and nuclear power) manager, Dr. E. C. Rhodes.

Mr. L. W. Johnson, at present assistant manager of the department, having reached retirement age has relinquished his appointment.

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Mr. G. J. Lyons has been appointed secretary of **The Institution of Plant Engineers** in succession to Mr. R. F. Farmer who has taken up an appointment with **The Institute of Civil Engineers.**

MEETINGS OF THE MONTH

December 15
Institute of Metal Finishing (South West Branch). Open Forum, at the Royal Hotel, Bristol. 7.30 p.m.

December 16
Institute of Metal Finishing (Organic Finishing Group). "Polyurethane finishes and foams," by R. Hurd, at the Engineering Centre, Stephenson Place, Birmingham. 6.30 p.m.

December 18
Institute of Metal Finishing (Sheffield and North East Branch). "Time and motion study in metal finishing," by K. B. Glassby, at the Grand Hotel, Sheffield. 7 p.m.

December 21
Institute of Metal Finishing (London Branch). Film evening, at the Northampton Polytechnic, St. John Street, London, E.C.1. 6.15 p.m.

January 5
Institute of Metal Finishing (Midland Branch). "Materials of construction for plating plant," symposium, at the James Watt Institute, Great Charles Street, Birmingham. 6.30 p.m.

January 5
Institution of Plant Engineers (Peterborough Branch). "The use of plastics in engineering," by C. L. Child (I.C.I.) Ltd., at the White Lion Hotel, Church Street, Peterborough. 7.30 p.m.

January 5
Institution of Plant Engineers (Edinburgh Branch). "The practice of thermal insulation," by Andrew and Angus George (Scottish Insulation Co. Ltd.), at 25, Charlotte Square, Edinburgh. 7 p.m.

January 8
Society of Instrument Technology (Midland Section). "Automatic weighing," by R. W. Seymour-Lee, at the Gosta Green College of Technology, Birmingham. 7 p.m.

January 11
Society of Chemical Industry (Oil and Fats Group joint meeting with Surface Activity Group). "Emulsions in theory and practice," by C. G. Sumner, at 14, Belgrave Square, London, S.W.1. 5.30 p.m.

January 12
Institute of Vitreous Enamellers (Scottish Section). Annual dinner, at the Plough Hotel, Stenhousemuir. 7.15 p.m.

January 13
Institute of Metal Finishing (Organic Finishing Group). "Stoving paint systems," by A. W. Greig and F. G. Randall, at the British Institute of Management, 80, Fetter Lane, London, E.C.4. 6.30 p.m.

January 13
Institution of Plant Engineers (Dundee Branch). "Surveying electrical equipment to comply with the Factories Act," by J. Townsley, at Taypark hotel, West Ferry, Dundee. 7.30 p.m.

January 14
Institution of Plant Engineers (North East Branch). "Pipeline cleaning techniques," by M. Webb (General Descaling Co. Ltd.), at Roadway House, Oxford Street, Newcastle-upon-Tyne. 7 p.m.

January 14
Birmingham Paint Varnish and Lacquer Club. Annual General Meeting at the Imperial Hotel, Temple Street, Birmingham. 7.50 p.m.

January 20
Institute of Vitreous Enamellers (Southern Section). "Some aspects of pre-enamelling control and technique," by A. K. Williams, at the Howard Hotel, Norfolk Street, London, W.C.2. 7.15 p.m.

January 21
Institute of Vitreous Enamellers (Midland Section). "Consumer promotion by the V.E.D.C.," by K. Jones, at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham. 7.30 p.m.

British and U.S. companies linked to make air impellers

AS a result of an agreement between S. Smith and Sons (England) Ltd. and the Torrington Manufacturing Co. of Torrington, Connecticut, U.S.A., a newly formed department of the Smiths organisation will manufacture Torrington air impellers and market them throughout the world, with the exception of the Americas.

The British company's products will be known as Smiths Torrington air impellers, and will be made and marketed by Smiths' recently established air impeller department, based at the Witney sub-division of Smiths Motor Accessory Division.

Mr. J. S. Ward, who joined Smiths six years ago, has been appointed sales manager of the new department. For some years past there has been an agreement permitting fans of Torrington design to be made by Smiths for inclusion in their own products.

Standard sizes of Smiths Torrington impellers are from 1½ in. to 11 in. dia. for centrifugal types and from 3 in. to 24 in. dia. in axial types.

KESTNER M.D's ANTIPODES TOUR

JOINT managing director of the Kestner Evaporator and Engineering Co. Ltd., London, Mr G. H. Black left recently to visit interests in America and Australia.

The first week of the trip was spent in America and the remainder of the time in Australia. He is a director of Kestner Australia Pty. Ltd.

U.S. "Duracron" resins made in U.K. for one-coat paint formulations

AN agreement has been made between Pittsburgh Plate Glass International S.A. and Styrene Co-Polymers Ltd. whereby the latter have the right to manufacture under licence and to market in the U.K. and certain other countries the Duracron range of thermosetting acrylic resins covered by the Pittsburgh Plate Glass Co's patent.

To be marketed under the name Scopacron. the range will include thermosetting acrylic resins corresponding to those already established in the United States.

The Scopacron resins are produced by the reaction of long-chain interpolymers containing amide side groups with formaldehyde. This produces resins containing methylol groups which are characterised by thermo-setting properties.

The fundamental advantage claimed for these new products over the existing thermosetting resins (e.g. phenolics, urea and melamine resins) is that desirable properties such as adhesion, flexibility and film hardness are obtained by the use of different polymerisable vinyl monomers.

This is in contrast with some conventional types where such properties are often only obtained by intensive external modification, often to the detriment of other properties.

In the formulation of stoving enamels, the makers say that Scopacrons enable a one-coat enamel to be manufactured.

NEW COMPANIES

" Ltd " is understood also " Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Beverley Williams, 5, St. Pauls Street, Leeds, 1. October 2. £1,000. To carry on bus. of manufacturers of and dealers in paint, etc. Edward J. Williams, George Beverley.

Heatplan, 7, Great Newton Street, Liverpool, October 5. £1,000. To carry on the bus. of heating and air conditioning engineers, etc. John B. Tomkinson, Philip D. Tomkinson.

Aquabenders, Excise Chambers, Pelham Street, Nottingham. October 5. £5,000. To carry on bus. of importers, exporters, distributors, servicers, manufacturers of and dealers in drying, cleaning, storing, heating, lighting, and domestic household, commercial and industrial appliances; mechanical, electrical, motoring and general engineering appliances, etc. Graham C. May, Barrie J. Abrahams, Edward E. Lacey and Herbert Lacey.

P. and W. Services, 15/16, Rathbone Place, W.1. October 6. £100. To carry on bus. of heating and ventilating and fire protection experts and advisers, etc. Walter R. Howard, Philip J. Howard.

Streamline Metal Services, 19, Fernside Road, Balham, S.W.12. October 7. £1,000. To carry on the bus. of heating and ventilating engineers. Augustus S. C. Moth, Ellenor S. F. Moth.

Paint Removers, 37, Queen Square, London, W.C.1. October 9. £100. To carry on bus. of manufacturers of and dealers in paint removers etc. Eric B. Calvert and Charles C. Longstaff.

Electroplate (Cardiff), 53, Cathedral Road, Cardiff. October 13. £2,500. Thomas W. Castle, Glen Rosa, Roger P. F. Llewellyn.

Farwell-Harris (Manufacturing), 18, Imperial Square, Cheltenham, Glos. October 13. £1,000. To carry on bus. of manufacturers of and dealers in domestic and industrial washing and drying machines, mangles, wringing machines, etc. Roy Farwell and Mrs. Frances L. Harris.

Thermalon, 1, Avery Row, W.1. October 13. £100. To carry on bus. of insulating specialists, thermal insulation engineers, etc. Jakob Pomeraniec, Robert E. Lyam.

Flow Developments, Kenrick Street, Netherfield, Nottingham. October 16. £100. To carry on bus. of manufacturers of and dealers in equipment for metering of fluids, engineers, etc. Norman S. Rutherford, Margaret Turner.

PLATING PLANT DISTRIBUTORS' CONFERENCE

TWENTY-THREE delegates from twelve European countries were present at the third biennial EFCO-Udylite distributors' conference that took place at Weybridge, Surrey, from October 7-9, under the auspices of the Electro-Chemical Engineering Co. Ltd.

EFCO-Udylite distributors are independent companies supplying and servicing Udylite automatic electroplating plant and processes throughout Europe and the British Commonwealth, working closely with the Udylite Corp. of Detroit — one of the world's largest electroplating supply organisations.

Mr. L. K. Lindahl, chairman of the Udylite Corporation, and Dr. H. Brown, director of research of the Udylite Research Corp. were present at the conference, which was primarily concerned with technical matters and at which some fifteen papers were given.

Seen above, left to right, are Mr. U. Stein and Mr. A. Stein (Industria Metalchimica, Italy); Dr. A. Hoch (Friedr. Blasberg, Germany); Mr. R. Corbière (Ets. R. Corbière, Belgium); Mr. L. Ades (Stè. Continentale Parker, France); Mr. J. Corbière (Ets. R. Corbière); Mr. J. C. Prier (Stè. Continentale Parker); and Dr. H. Brown (Udylite Research Corp., U.S.A.).

Metafil Manufacturing, 122a, Anerley Road, Anerley, S.E.20. October 20. £1,000. To carry on bus. of manufacturers and suppliers of plastic metal, chemical manufacturers, manufacturing chemists; to acquire the trade mark " Metafil," and the goodwill in connexion therewith. John Compton, Norman P. Austen.

Metal Service, 26, Victoria Street, Luton. October 23. £1,000. To carry on the bus. of heating and ventilating and fire protection experts and advisers, manufacturers of and dealers in stoves, ranges, etc. Cyril E. Oakins, Philip T. Morom, John Henderson.

Appleby Abrasives, October 27. £100. Geoffrey W. Wells, John G. T. Eccles and Leonara G. Clugston.

L. A. Brook of Dewsbury, 154, Bradford Road, Dewsbury. October 29. £20,000. To carry on bus. of manufacturers of cleaning cloths, wiping rags, etc.

Bennis Thermoflash, Little Hulton, Walkden, Manchester. October 30. £10,000. To carry on bus. of designers and manufacturers of water distillation plant and heat exchange equipment, etc. Thomas M. Dickson, Cecil H. Hughes, John P. Lauder, Jack Seymour.

Ion Exchange Survey. October 30. £100. To carry on bus. of manufacturers of and dealers in chemicals, etc.

J. Martin (London), 469, New Cross Road, S.E.14. November 4. £5,000. To carry on bus. of heating, ventilating and general engineers, etc. Alfred J. A. Martin and Amy R. Martin. George E. Martin, Richard H. E. Martin, Wm. C. Martin, Arthur E. Martin, Thomas H. Sewell.

Thursfield Plating, 14-18, High Holborn, W.C.1. November 6. £1,000. To carry on bus. of electro, nickel and chromium platers, etc. John R. Thursfield, Richard Chapman, John G. Thursfield.

From the Register compiled by Jordan & Sons Ltd. 16 Chancery Lane, London, W.C.2.

Guarding the jetty at Thameshaven

CORROSION PROTECTION WITH BI-METALLIC ANODES

IN the larger picture above, of the oil jetty at Thameshaven, cathodic protection of the 15,000 sq. ft. structure is afforded by four 2-ft. long x $\frac{3}{4}$-in. dia. platinised titanium anodes attached to the pile in the centre of the picture. The smaller illustration on the right shows the method of mounting the anodes in a frame clamped to the timber.

In practice, the negative lead of a d.c. source is attached to the structure, and the positive lead to the anode, formed of titanium coated with an extremely thin and not necessarily continuous film of platinum. The bi-metallic anodes will carry very heavy anodic currents without harmful effect on the titanium. By making the bulk of the anode in titanium, its inherent advantages of light weight, resistance to erosion, and comparative cheapness, are retained.

The anodes use an impressed current. By adopting the method of anodic polarization, titanium can be used in such applications where it would otherwise become corroded. The protective film formed by the anodic process resists the passage of current to an electrolyte but conducts current to another metal in contact with it.

Public admittance to trade mark hearings

THE Board of Trade have introduced rules made under the Trade Marks Act, 1938 and the Registered Designs Act, 1949, providing for the admittance of the public to the hearing of certain trade marks and designs matters by the Registrar.

The new amendments require the Registrar to hear in public any dispute between two or more parties in connection with a trade mark or an application to register a trade mark, or any dispute relating to a registered design, unless, after consultation with the parties represented at the hearing, he otherwise directs.

Hitherto the public have had no right of admission to such hearings. In order to give the parties notice of the change in practice, the new rules will not come into operation until February 22, 1960.

Copies of the new rules can be obtained from H.M. Stationery Office, Kingsway, London, W.C.2.

BIRLEC NAME-CHANGE

THE name of Birlec Ltd., Erdington, Birmingham 24, is to be changed to A.E.I.-Birlec Ltd.

The change is in accordance with the reorganisation of the parent company, Associated Electrical Industries, Ltd., into several product divisions, and the internal organisation of Birlec Ltd. will not be affected. The manufacture of heat treatment furnaces, gas plants and adsorption dryers will continue as before.

The name of its associate company, Birlec-Efco (Melting) Ltd., will not be changed.

* * *

A BRANCH office of Griffin and George, Ltd., Ealing Road, Alperton, Wembley, Mddx., has been opened at 626, Welbeck Road, Walker, Newcastle-on-Tyne.

OBITUARY

Death of Dennis Sleath

It is with profound regret that we announce the sudden death on November 28 of Mr. Dennis Sleath, the midlands area manager of Borax Consolidated Ltd. He was 45.

Mr. Sleath had been with Borax Consolidated since 1936, and after war service in the Army Intelligence Corps, was appointed in 1945 to the position he occupied at the time of his death.

He was well known to readers of this journal as the honorary secretary of the Midland section of the Institute of Vitreous Enamellers. He attended many of the Institute's international conferences where his knowledge of languages was a great asset.

Mr. Sleath was widely respected and had many friends in a great variety of industries from South Wales to the Wash. He leaves a wife and five children.

Ideal Home Exhibition

THE Daily Mail Ideal Home Exhibition of 1960 will be held, as usual, at Olympia. It will open on March 1, and close on March 26.

Its main feature will be a Georgian house built at the west end of the Grand Hall and approached by a formal drive through superb gardens. The house will be an authentic reproduction of a house of about 1720, in the golden age of British architecture.

Trade and Technical Publications

A double-sided sheet has been issued by Glen Creston Ltd., 41, Church Road, Stanmore, Mddx., giving details of their micro-mixer mill and sample mixer mill, two pieces of equipment designed for ultra-fine rapid grinding and mixing of small samples in infra-red spectroscopy, analytical chemistry, powder metallurgy, and other applications.

Grinding or mixing in the micro mixer mill is effected in small stoppered vials of either 2 or 5 ml. capacity made of plastic, stainless steel, hardened tool steel or agate. The sample is inserted into the vial together with an appropriate ball pestle. The filled vial is placed into a pair of clips on top of the mill housing, the clips being oscillated by the built-in motor in a figure "8" motion through an arc of 6½ deg. at 3200 r.p.m. The ball pestle inside the vial strikes four blows per cycle against the ends of the vials. In 15 seconds, the normal mixing time, some 3000 blows are thus struck. The standard instrument is fitted with a built-in timer from 0 to 60 seconds. A modified version is available with a 1-hour timer and fan-cooled motor.

A high-speed impact shaker, the sample mixer mill is designed for mixing and grinding laboratory size samples quickly. conveniently and uniformly. In optical emission and x-ray spectrographic laboratories this instrument is ideal for mixing and grinding both samples and standards. The entire mechanism is enclosed in a sheet metal housing with a hinged door which controls a safety switch. A timer automatically turns the sample mixer mill off after any pre-set time up to one hour. A parallel switch permits operation for longer periods. Although the impact is very vigorous, adequate shock mounting permits the instrument to be placed on a table with very little vibration. Not only is the effort of mortar and pestle labour eliminated, but results are made more reproducible as consistency in particle size is attained every time.

* * *

Vitreous enamels with melting points so low that they can be used on 24-gauge aluminized steel and on sheet aluminium itself are described in the feature article of Lead, quarterly publication of the Lead Industries Association, 60, East 42nd Street, New York 17, N.Y., U.S.A. Useful to manufacturers of permanent outdoor signs, architects, and others searching for colour and extreme durability, the enamels are said to have several unique properties. Not only are they claimed to be of use on much lighter stock than conventional enamels, they are also said to form a thinner coat because they are more finely ground than usual vitreous frits. Furthermore, it is claimed that the desired opaqueness and finish can be obtained in a coat so thin that the enamelled sheet can be sawed, punched, sheared, or drilled without danger of serious spalling.

Minor spalling which may occur in such operations leads to no serious corrosion problem since an aluminium base is used.

* * *

In the electrodeposition section of the August issue of The Nickel Bulletin, attention is drawn to papers on the corrosion-resistance of duplex nickel coatings and to a comprehensive investigation of the production and properties of coatings deposited by thermal decomposition of nickel carbonyl. Reference is made to a paper describing the use of nickel-iron films in digital computers and, in the section on cast iron, to inoculation of castings by vibration during solidification. The eleven papers abstracted in the section concerned with nickel-containing constructional steels cover testing, fabrication, properties, susceptibility to embrittlement and applications in the automobile industry.

The literature on nickel-containing heat and corrosion-resisting materials ranges in its subject matter from precipitation reactions during ageing and the influence of hot working on creep properties, to fabrication, gas lubrication, and resistance to intergranular and pitting corrosion.

Five Tons to Chowringhee

LEAD COATED SHEETS FOR INDIA

A rush order of 5 tons of lead-coated sheets was flown to Calcutta recently so as to reach a customer in time to avoid a penalty clause in a contract.

An indication of what can be done with a combination of luck and bustle, Shimwell and Co., the suppliers, succeeded in providing the goods in Calcutta in a little over 24-hours from receiving the first telephone call.

A DC-4 was specially chartered for the flight to India, and the load made up of five 1-ton bundles is seen being manhandled aboard the aircraft at Southend.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Compact Ultrasonic Unit

A NEW, compact, ultrasonic cleaning system in a single cabinet, the "Sonogen" Model H-100, has been introduced by Branson Ultrasonic Corpn., Stamford, Conn., U.S.A. The unit is intended especially for laboratories. (Fig. 1).

A stainless steel transducerized cleaning tank, generator, and stainless steel rinse tank are housed in a stainless steel cabinet 44 in. x 33 in. x 42 in. high, with counter-top at a convenient height of 32 in. Designed as a basic module, the H-100 can be incorporated into a larger cleaning system. Transducerized rinse tank, heaters with thermostatic control timers, and recirculating filter can be easily added.

Flexible spray rinse and air blow-off lines are part of the unit, and both cleaning and rinsing tank have hot and cold water connections. Installation

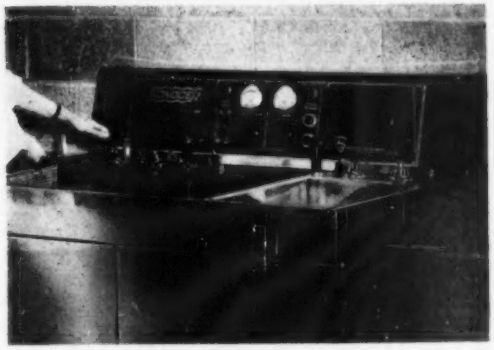


Fig. 1. *Ultrasonic cleaning equipment*

is simple and quick, all that is required being hot water, cold water, and drain connections to existing plumbing, and a 220-V., 60-cycle current source.

Industrial cleaning applications include delicate gyros, vacuum tubes, bearings, printed circuits, and even complete mechanical assemblies. The thoroughness of the Sonogen ultrasonic cleaners is an advantage in white rooms, where soil particles down to a few microns in size must be removed.

Ultrasonic energy at a nominal frequency of 40,000 cycles per sec. is generated electronically, and converted by a ceramic transducer into mechanical vibrations of the same frequency. Introduced into the cleaning liquid, these vibrations cause the cavitation used in ultrasonic cleaning.

A New Finishing Process

A MACHINE recently developed by the Harper Buffing Machine Co., of the U.S.A., and now being manufactured in this country by W. Canning and Co. Ltd., improves the finish of metal parts by processing in loose abrasives in a manner said to be quite different from conventional barrel finishing. Process times are reduced and it is possible to finish intricately contoured parts.

The machine (called the "Harperizer") uses fine loose abrasives. It is built to produce a high centrifugal force that holds the parts and media together in a tight mass. Abrasives and the parts being processed move slowly in relation to the other while in this tightly packed mass. As a result, certain types of intricately contoured parts can be uniformly smoothed to a finish comparable to that produced by buffing, and material removal is rapid, it is claimed.

The Harperizer consists of a number of containers mounted on a turret that revolves at speeds sufficiently fast for the weight of the workpieces and media to be increased through centrifugal force by 40 to 50 times. The containers are mounted so that they rotate on their own axes while the large turret is revolving. The containers are 37 in. long, with an inside diameter of 11 in. Removable dividers form compartments that make it possible to process products of different sizes, and all containers have resilient Neoprene rubber linings. Balancing the rotating turret and the containers is important, since the centrifugal force created is substantial. Thus, machines with several containers mounted on the turret must be carefully balanced so that they are in equilibrium when the machine is operating.

Both wet and dry media can be used and the media chosen should be fine enough to conform closely to the most intricate contours of the workpiece. Wet operations are successful in deburring and radiusing edges and in processing parts too small or too light for normal tumbling operations.

In operation, as rotation of the turret begins, centrifugal force gradually increases until the turret reaches normal running speed. The considerable force produced compacts the media and presses it against the sides of the container and against the parts. Since the container is rubber-lined, the media does not slide against the sides. Instead, the compacted abrasive

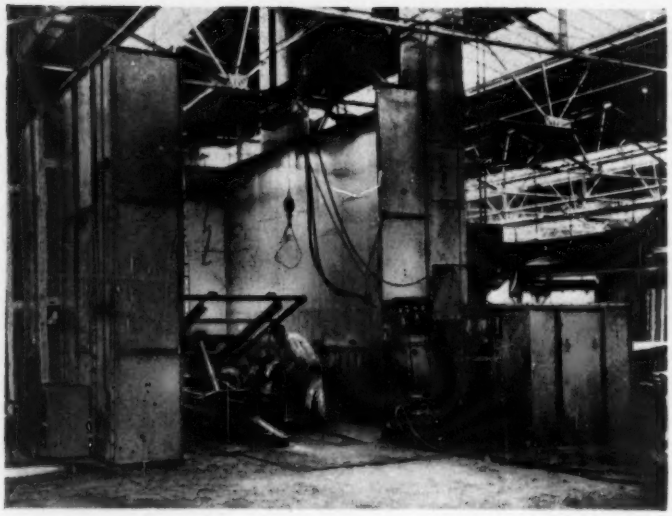


Fig. 2.—The conventional pump has been dispensed with in this water washed spay booth.

materials " walk " with a caterpillar-like motion around the inner wall of the container.

The combined result of the high centrifugal force and the movement is that parts being finished are held tightly within the abrasive mass and the abrasives gradually slide against the surface of the parts, removing metal from the surface and refining the finish. Materials are kept compacted at all times, " waterfalling " is avoided and there is no falling or " bombarding " of workpieces with abrasives.

Since the containers themselves are rotating, the position of greatest centrifugal force and the centre of stability constantly shifts within the container, so that all part surfaces are subjected to approximately the same action.

The sustained high pressure and slow movement of the work abrasives cause the abrasives to abrade all surfaces to a uniform depth. Forcing the abrasives against the parts also produces rapid cutting action and processing time is short.

The " Harperizer " probably is at its best, the makers say, in finishing parts that are difficult to process by conventional polishing methods. If the part has complicated contours that make hand polishing impractical or it is difficult to jig for automatic polishing machines, the " Harperizer " could be the answer. Besides producing a highly polished surface, the " Harperizer " also preserves detail of design.

Examples of the products that have already been successfully finished include cams (from 80 to 18 microinch finish without distorting contours), stainless steel flat ware with an ornamental design, steel golf-club heads, die castings and plumber's brassware.

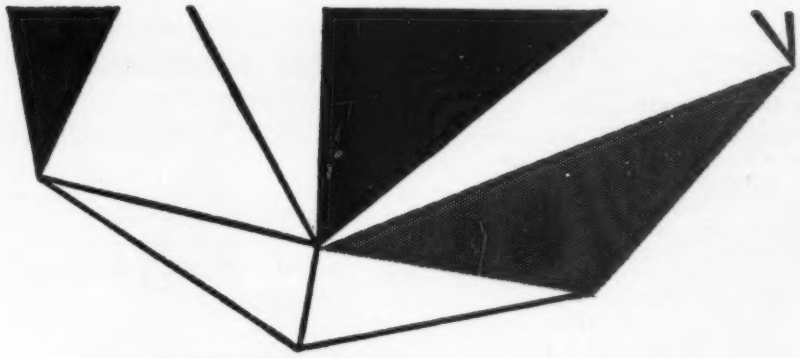
Spray Booth Uses Syphon Principle

THE water wash spray booth illustrated in Fig. 2 and designated the "Nopump" booth, is being marketed by Alfred Bullows and Sons Ltd., Walsall, Staffs. As its name implies, the booth has no pump, the conventional centrifugal, water-circulating pump with its attendant piping, nozzles and filters having been dispensed with.

In this booth, a stream of air at high velocity is used to entrain a large amount of water by being fed across its surface. This air-water mixture, still travelling at high velocity, is forced to make a number of carefully controlled changes of direction, during which the heavier paint particles are thrown, by centrifugal force, into the water stream. The water is then separated from the air by a number of eliminator plates, the clean, exhaust air being taken to atmosphere, and the water returning to the tank.

As there are no filters, the degree of contamination of the water has little or no effect on the operation of the booth, the makers claim. If the collected paint is encouraged to sink, the booth will go on running until the water tank is full of collected paint in the form of silt. There is no sacrifice of washing efficiency, according to Bullows who say that the exhaust air from a " Nopump " booth is outstandingly clean ; when handling ceramics, fillers, etc., there is nothing to be damaged by the abrasive residue. The power consumption is said to be approximately the same as that of a conventional water wash booth. One of the early booths installed is a 22 ft. 6 in. long x 13 ft. 6 in. wide downdraught booth at Massey-Ferguson (Great Britain) Ltd., Stretford, Manchester, shown in Fig. 2. Beginning production on March 1 this year, it has operated two nine-hour shifts per day ever since, on continuous painting of agricultural equipment. The makers say that when examined six months later, no cleaning out had been done and it was anticipated that the booth could run a further six months before this would be required. The fan and ducting were barely discoloured.

(*Continued in page* 472)



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Nickel sulphamate electrolytes can be used for building up worn parts and also for decorative finishes, as the deposits are exceptionally easy to polish.

A detailed investigation of the properties of electrolytes based on nickel sulphamate has been carried out in Albright & Wilson's pilot plant in their Technical Service Department at Oldbury.

Albright & Wilson (Mfg) Ltd also supply Phosbrite chemical polishing solutions for copper and aluminium and their alloys, Plusbrite addition agents for bright nickel plating, together with chemicals for special processes in tin and copper plating and electrolytic polishing of ferrous metals.

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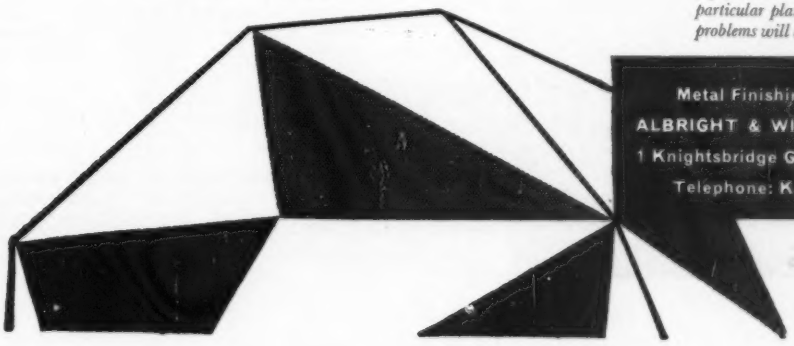

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Plant, Proceses, etc.

(*Continued from page* 470)

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THE Sturtevant Engineering Co. Ltd. announce in conjunction with Acalor (1948) Ltd. that in addition to the range of moulded PVC fans based on their original " Monogram " series, they have now produced a range of fans to handle corrosive fumes and gases based on their original "D" series.

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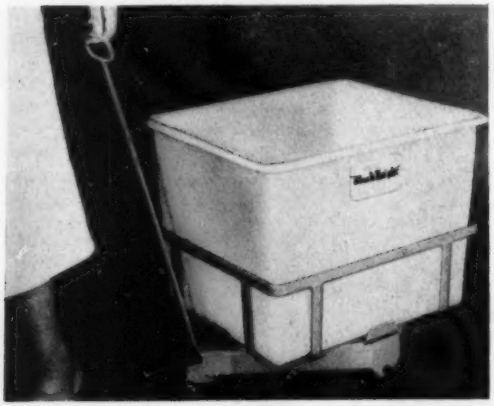
INTRODUCED by Tool Treatments (Chemicals) Ltd., Colliery Road, Birmingham Road, West Bromwich the new " Mini-Bogie " illustrated in Fig. 3 presents a quick, easy and economical method of man-handling a wide range of commodities within factories. A rigid polythene container size 18 in. x 15 in. x 13½ in. is mounted on an ingenious transporter that can be easily pulled along the straight or swivelled round on its own axis to negotiate awkward spaces. The bin is a robust, product quite suitable for use as a transporter for such items as nuts and bolts and other small engineering component parts.

Fig. 3—Polythene container on bogie



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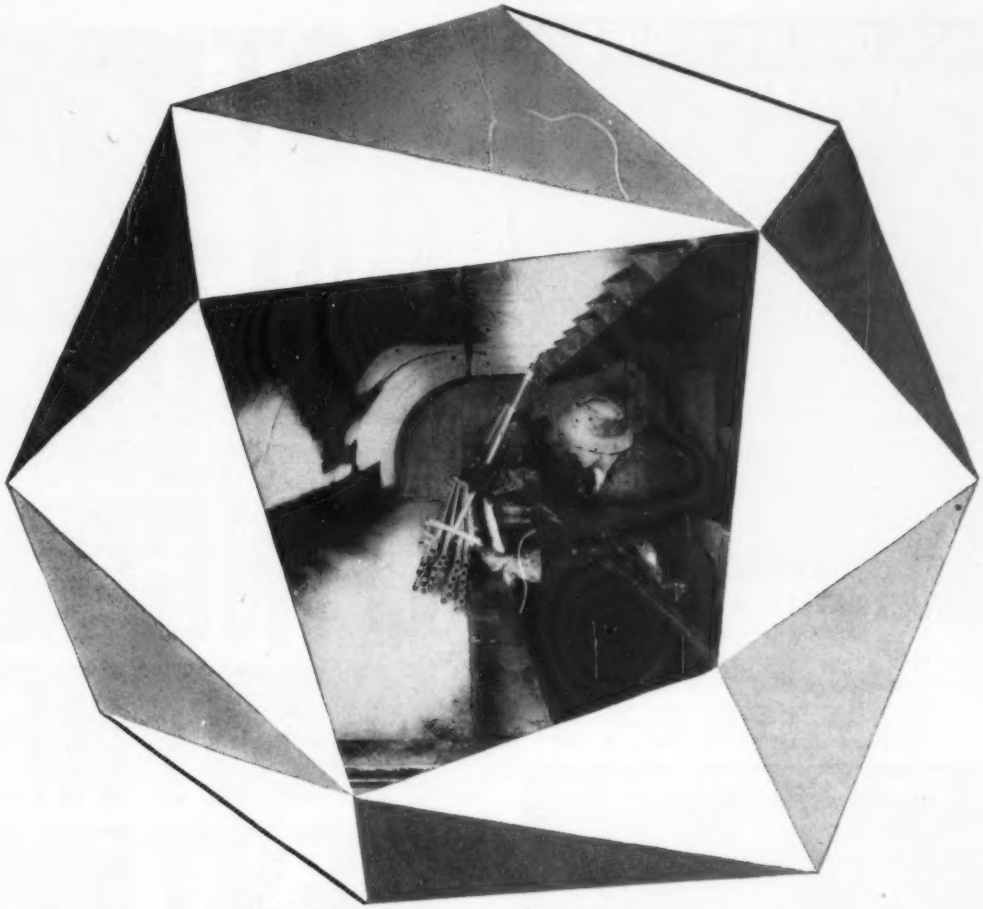
PATENT

The Proprietors of **British Patent No. 697904** are prepared to sell the patent or to licence British manufacturers to work thereunder. It relates to a Method for fixing Glass Denses on Vitreous Enamelled Boards. Address: Boult Wade & Tennant, 112, Hatton Garden, London, E.C.1.



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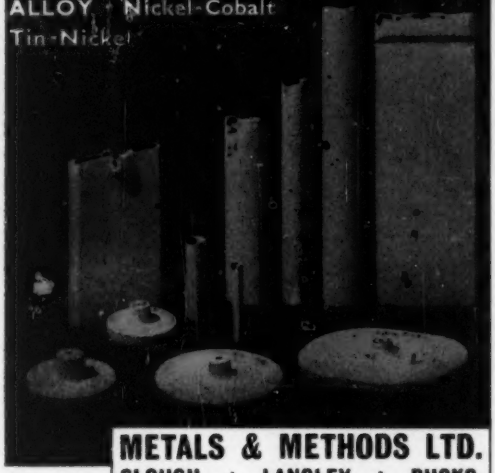

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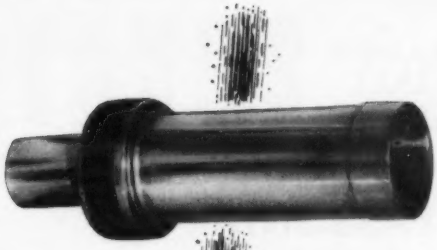

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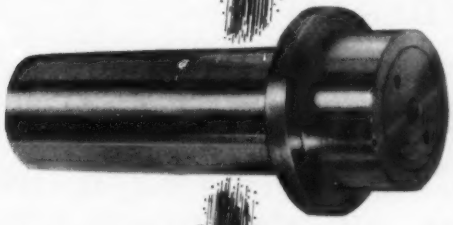

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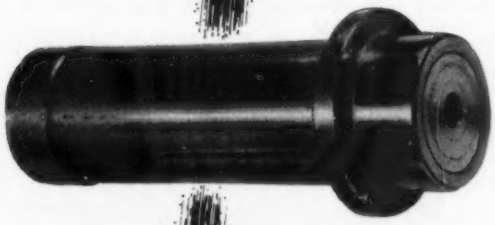

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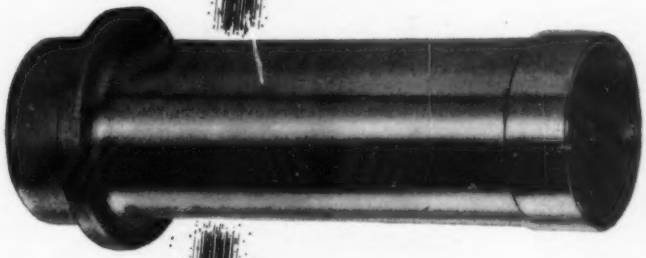

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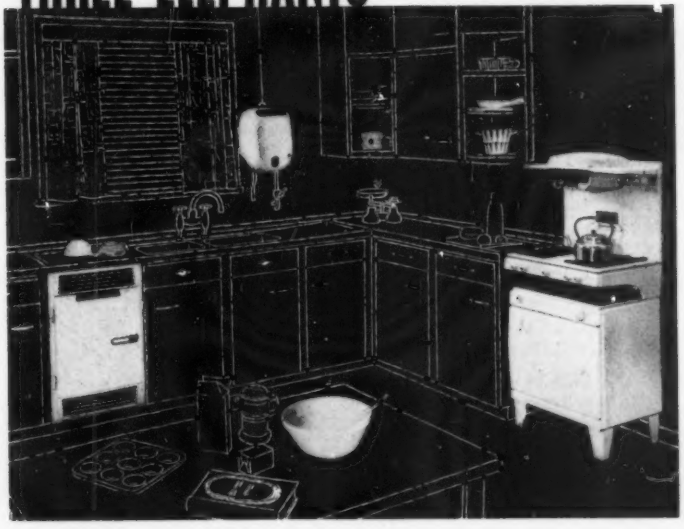

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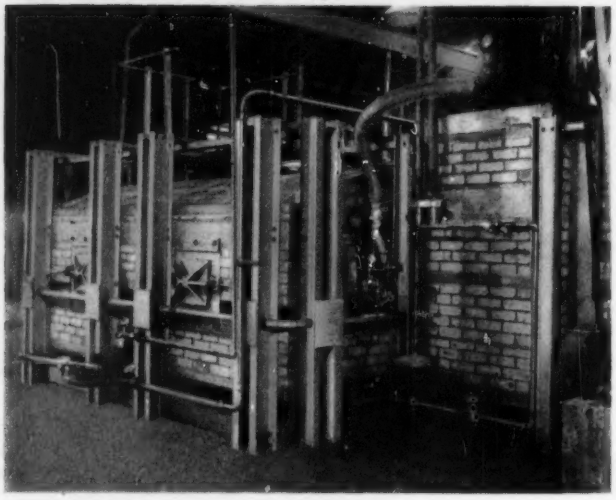

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	Page
Aerograph Co. Ltd.	—
Albright & Wilson (Mfg.) Ltd.	26, 27 & 29
Alkan. M. L., Ltd.	—
Alumilite & Aizak Ltd.	—
Analytical Measurements Ltd.	—
Anti-Dust Services Ltd.	—
Associated Electrical Industries Ltd.	15
Atlas Copco (Great Britain) Ltd.	3
Ballard, F. J., & Co. Ltd.	4
Berger, Lewis & Co. Ltd.	7
Bilston Shot & Grit Co. Ltd.	—
Blake Vitreous Enamelling Ltd.	—
Blythe Colour Works Ltd.	2
Borax & Chemicals Ltd.	33
Borax Consolidated Ltd.	22
British Chrome & Chemicals Ltd.	35
British Paints Ltd.	9
British Titan Products Co. Ltd.	—
Brotherton & Co. Ltd.	—
Canning, W., & Co. Ltd.	18 & 19
Cruickshank, R., Ltd.	—
Dawson Bros. Ltd.	24
Electro Chemical Engineering Co. Ltd.	14
English Abrasives Corporation Ltd.	6
Escol Products Ltd.	5
Gas Council	36
Glebe Mines Ltd.	—
Glostics Ltd.	31
Griffiths, A. E. (Smethwick), Ltd.	20
Hawley, John, & Co. (Walsall) Ltd.	30
Hockley Chemical Co. Ltd.	12
Hot Dip Galvanizers Association	30
Imperial Chemical Industries Ltd.	—
Impregnated Diamond Products Ltd.	31
Incandescent Heat Co. Ltd.	17
Kemball, Bishop & Co., Ltd.	—
Laporte Chemicals Ltd.	21
Laporte Titanium Ltd.	10
Main Enamel Manufacturing Co. Ltd.	8
Metals & Methods Ltd.	30
Metropolitan-Vickers Electrical Co. Ltd.	15
Minnesota Mining & Manufacturing Co. Ltd.	—
Mond Nickel Co. Ltd. (The)	25
Morris, B. O., Ltd.	13
Nash & Thompson Ltd.	—
Newton Plating Jigs & Insulations Ltd.	16
Nu-Way Heating Plants Ltd.	11
Oakey, John & Sons	32
Pye, W. G., & Co. Ltd.	—
Pyrene Co. Ltd.	—
Shell Chemical Co. Ltd.	—
Silvercrown Ltd.	—
Sismey & Linforth Ltd.	34
Stordy Engineering Ltd.	—
Stuart, Robert, (London), Ltd.	16
Summers, John, & Sons Ltd.	—
T.C. Spray Finishing Systems	—
Thomas (Richard) & Baldwins Ltd.	1
Thompson Bros. (Bilston) Ltd.	—
Ultrasonic Applications Ltd.	—
Union Oxide & Chemical Co. Ltd.	—
Volspray Ltd.	—
Wallace & Tiernan Ltd.	—
Walterisation Ltd.	32
Wengers Ltd.	—
Zinc Alloy Rust-Proofing Co. Ltd.	33

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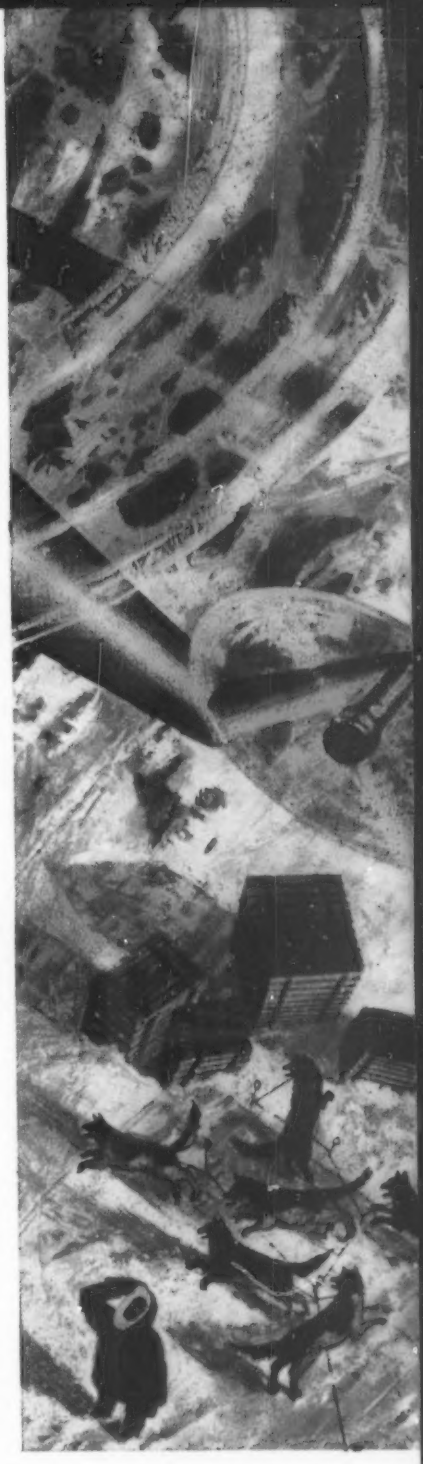

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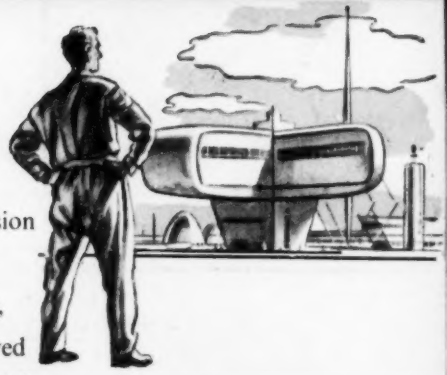

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